The following document contains information on Cypress products. The document has the ordering part numbering with the prefix “S”. Cypress will offer these products to new and existing customers with the updated ordering part number (updated last digit).

How to Check the Ordering Part Number

1. Go to www.cypress.com/pcn.
2. Enter the keyword (for example, ordering part number) in the **SEARCH PCNS** field and click **Apply**.
3. Click the corresponding title from the search results.
4. Download the Affected Parts List file, which has details of all changes

For More Information

Please contact your local sales office for additional information about Cypress products and solutions.

About Cypress

Cypress is the leader in advanced embedded system solutions for the world's most innovative automotive, industrial, smart home appliances, consumer electronics and medical products. Cypress' microcontrollers, analog ICs, wireless and USB-based connectivity solutions and reliable, high-performance memories help engineers design differentiated products and get them to market first. Cypress is committed to providing customers with the best support and development resources on the planet enabling them to disrupt markets by creating new product categories in record time. To learn more, go to www.cypress.com.

S6E1C Series

32-bit ARM® Cortex®-M0+ FM0+ Microcontroller

The FM0+ family of Flexible Microcontrollers is the industry's most energy-efficient 32-bit ARM® Cortex®-M0+ based MCUs. This family of MCUs is designed for ultra-low-power and cost-sensitive applications such as white goods, sensors, meters, HMI systems, power tools and Internet of Things (IoT) battery-powered or wearable devices.

This family of ultra-low-power MCUs features an industry-leading 35 µA/CoreMark® score and 40µA/MHz Active Power consumption.

The S6E1C Series is a series of highly integrated 32-bit microcontrollers designed for embedded controllers aiming at low power consumption and low cost. This series has the ARM Cortex-M0+ Processor with on-chip Flash memory and SRAM, and consists of peripheral functions such as various timers, ADC and communication interfaces (UART, CSIO (SPI), I^2C, I^2S, Smart Card, and USB). The products which are described in this data sheet are placed into TYPE3-M0+ product categories in "FM0+ Family Peripheral Manual".

Features

Ultra Low Power MCU Subsystem

- 40 MHz ARM Cortex-M0+ CPU with 1.65 V to 3.6 V operating voltage
- Maximum operating frequency: 40.8 MHz
- Nested Vectored Interrupt Controller (NVIC): 1 non-maskable interrupt (NMI) and 24 peripheral interrupt with 4 selectable interrupt priority levels
- 24-bit System timer (Sys Tick): System timer for OS task management
- Up to 128 KB Flash, 16 KB SRAM
- Descriptor System Transfer Controller (DSTC)
- Industry's most efficient 35 µA/CoreMark Score
- Ultra-low-power consumption: Active – 40 µA/MHz and Standby – 0.6 µA
- Fast wake-up from standby mode (execute from Flash): 20 µs (Typ)

Digital Subsystem

- Up to 8x Base Timers
- 1x Dual Timer, 1x Watch Counter
- Up to 6x Multi-Function Serial (MFS) interfaces configurable as SPI, UART, I^2C
- Up to 1x USB, up to 2x I^2S, up to 2x HDMI-CEC, up to 1x Smart Card interfaces

Analog Subsystem

- 1x 12-bit, 1-Msps ADCs with an 8-channel multiplexer input
- 1% high precision internal oscillator

Package Options

- 32-/48-/64-pin LQFP
- 32-/48-/64-pin QFN
- 30-pin WLCSP

Low-Power Consumption Modes

- This series has six low-power consumption modes:
  - Sleep
  - Timer
  - RTC
  - Stop
  - Deep standby RTC (selectable between keeping the value of RAM and not)
  - Deep standby Stop (selectable between keeping the value of RAM and not)

Ecosystem for Cypress FM0+ MCUs

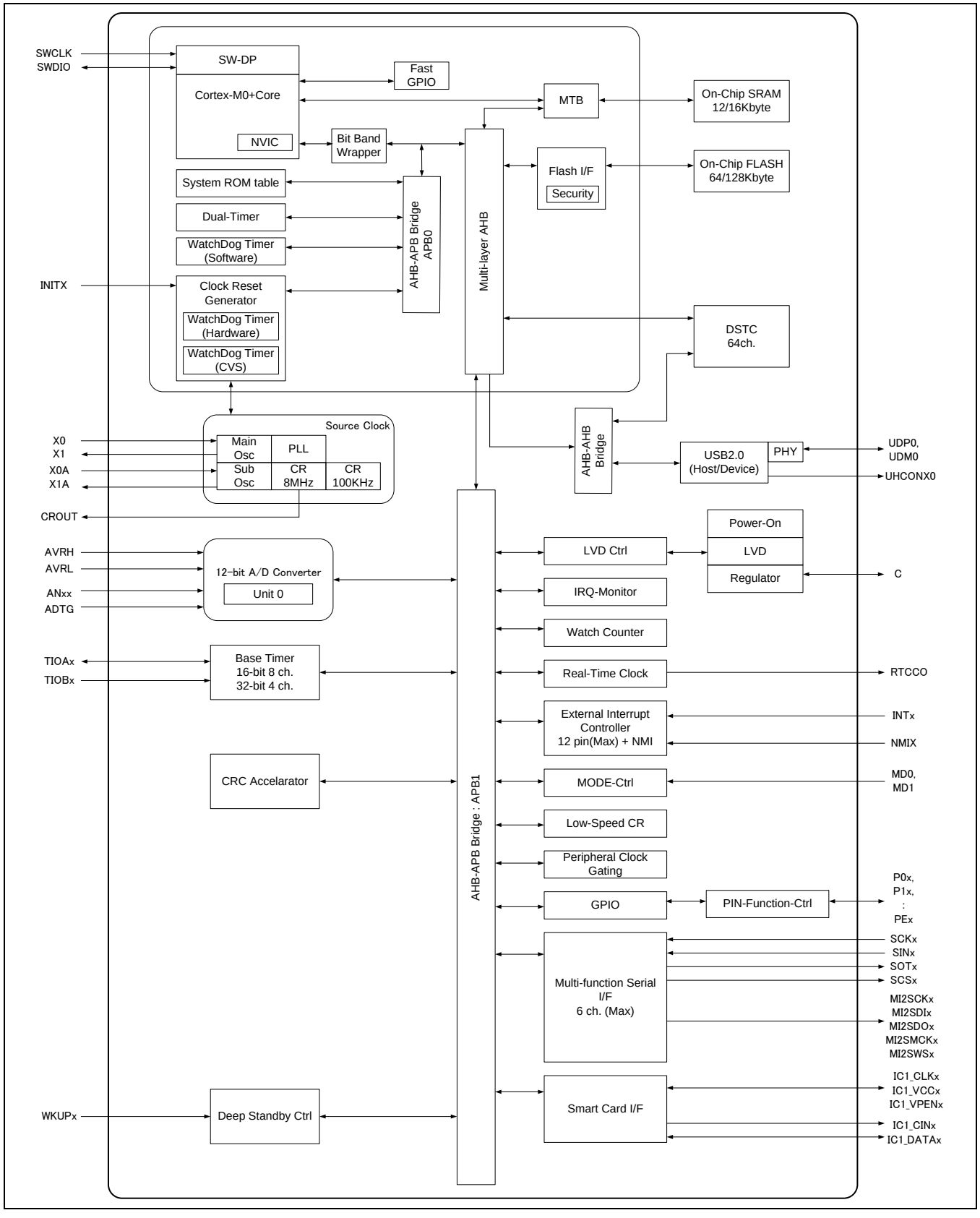
Cypress provides a wealth of data at www.cypress.com to help you to select the right MCU for your design, and to help you to quickly and effectively integrate the device into your design. Following is an abbreviated list for FM0+ MCUs:

- Overview: Product Portfolio, Product Roadmap
- Product Selectors: FM0+ MCUs
- Application notes: Cypress offers a large number of FM0+ application notes covering a broad range of topics, from basic to advanced level. Recommended application notes for getting started with FM0+ family of MCUs are:
  - AN210985 – FM0+ Getting Started with FM0+ Development: AN210985 introduces you to the FM0+ family of 32-bit general-purpose microcontrollers. The FM0+ family is based on the ARM® Cortex®-M0+ processor core, ideal for ultra-low-power designs. This note provides an overview of hardware features and capabilities, firmware development, and the multitude of technical resources available to you. This application note uses the FM0+ S6E1B8-Series Starter Kit as an example.
  - AN203277 - FM 32-Bit Microcontroller Family Hardware Design Considerations: This application note reviews several topics for designing a hardware system around FM0+, FM3, and FM4 family MCUs. Subjects include power system, reset, crystal, and other pin connections, and programming and debugging interfaces.
  - AN205411 – FM0+ IEC60730 Class B Self-Test Library : This document covers how to use and implement the library functions provided. It will first show the requirement of IEC60730 Class B, and then explain how it can be implemented. At last an example is given to show how to integrate test functions into a real system.
  - AN202487 - Differences Among FM0+, FM3, and FM4 32-Bit Microcontrollers: Highlights the peripheral differences in Cypress's FM family MCUs. It provides dedicated sections for each peripheral and contains lists, tables, and descriptions of peripheral feature and register differences.
  - AN204438 - How to Setup Flash Security for FM0+, FM3 and FM4 Families: This application note describes how to setup the Flash Security for FM0+, FM**3**, and FM4 devices
- Development kits:
  - FM0-V48-S6E1A1 ARM® Cortex®-M0+ FM0+ MCU Evaluation Board
  - FM0-64L-S6E1C3 - ARM® Cortex®-M0+ MCU Starter Kit with USB and Digital Audio Interface
- Peripheral Manuals

Table of Contents

Features **1**
1. Block Diagram **4**
2. Product Lineup **5**
2.1 Package Dependent Features 6
2.2 Packages 6
3. Product Features in Detail **7**
4. Pin Assignment **10**
5. List of Pin Functions **17**
6. I/O Circuit Type **26**
7. Handling Precautions **31**
7.1 Precautions for Product Design 31
7.2 Precautions for Package Mounting 32
7.3 Precautions for Use Environment 34
8. Handling Devices **35**
9. Memory Map **38**
10. Pin Status in Each CPU State **41**
11. Electrical Characteristics **44**
11.1 Absolute Maximum Ratings 44
11.2 Recommended Operating Conditions 45
11.3 DC Characteristics 46
11.3.1 Current Rating 46
11.3.2 Pin Characteristics 51
11.4 AC Characteristics 52
11.4.1 Main Clock Input Characteristics 52
11.4.2 Sub Clock Input Characteristics 53
11.4.3 Built-in CR Oscillation Characteristics 54
11.4.4 Operating Conditions of Main PLL (In the Case of Using the Main Clock as the Input Clock of the PLL) 55
11.4.5 Operating Conditions of Main PLL (In the Case of Using the Built-in High-Speed CR Clock as the Input Clock of the Main PLL) 55
11.4.6 Reset Input Characteristics 56
11.4.7 Power-on Reset Timing 56
11.4.8 Base Timer Input Timing 57
11.4.9 CSIO/SPI/UART Timing 58
11.4.10 External Input Timing 75
11.4.11 I^2C Timing 76
11.4.12 I^2S Timing (MFS-I2S Timing) 77
11.4.13 Smart Card Interface Characteristics 79
11.4.14 SW-DP Timing 80
11.5 12-bit A/D Converter 81
11.6 USB Characteristics 84
11.7 Low-Voltage Detection Characteristics 89
11.7.1 Low-Voltage Detection Reset 89
11.7.2 Low-Voltage Detection Interrupt 90
11.8 Flash Memory Write/Erase Characteristics 91
11.9 Return Time from Low-Power Consumption Mode .. 92
11.9.1 Return Factor: Interrupt/WKUP 92
11.9.2 Return Factor: Reset 94
12. Ordering Information **96**
13. Acronyms **97**
14. Package Dimensions **99**
15. Errata **106**
15.1 Part Numbers Affected 106
15.2 Qualification Status 106
15.3 Errata Summary 106
Document History **108**
Sales, Solutions, and Legal Information **109**

1. Block Diagram



2. Product Lineup

Memory Size

Product name	S6E1C11 S6E1C31	S6E1C12 S6E1C32
On-chip Flash memory	64 Kbytes	128 Kbytes
On-chip SRAM	12 Kbytes	16 Kbytes

Function

Function Name		S6E1C1	S6E1C3
CPU		Cortex-M0+	
	Frequency	40.8 MHz	
Power supply voltage range		1.65 V to 3.6 V	
USB2.0 (Device/Host)		-	1 unit
DSTC		64 ch.	
Base Timer (PWC/Reload timer/PWM/PPG)		8 ch. (Max)	
Dual Timer		1 unit	
Real-time Clock		1 unit	
Watch Counter		1 unit	
CRC Accelerator		Yes	
Watchdog timer		1 ch. (SW) + 1 ch. (HW)	
CSV (Clock Supervisor)		Yes	
LVD (Low-voltage Detection)		2 ch.	
Built-in CR	High-speed	8 MHz (Typ)	
	Low-speed	100 kHz (Typ)	
Debug Function		SW-DP	
Unique ID		Yes	

Note:

- *Because of package pin limitations, not all functions within the device can be brought out to external pins. You must carefully work out the pin allocation needed for your design.*
  You must use the port relocate function of the I/O port according to your function use.
- *See "11. Electrical Characteristics 11.4 AC Characteristics 11.4.3 Built-in CR Oscillation Characteristics" for accuracy of built-in CR.*

2.1 Package Dependent Features

Feature	Package			
	30 WLCSP	**32 LQFP 32 QFN**	**48 LQFP 48 QFN**	**64 LQFP 64 QFN**
Pin count	30	32	48	64
Multi-function Serial Interface (UART/CSIO/I²C/I²S)	4 ch. (Max) Ch.0/1/3 without FIFO Ch. 6 with FIFO	4 ch. (Max) Ch.0/1/3 without FIFO Ch. 6 with FIFO	6 ch. (Max) Ch.0/1/3 without FIFO Ch.4/6/7 with FIFO	6 ch. (Max) Ch.0/1/3 without FIFO Ch.4/6/7 with FIFO
	I²S: No		I²S: 1 ch (Max) Ch. 6 with FIFO	I²S: 2 ch (Max) Ch. 4/6 with FIFO
External Interrupt	7 pins (Max), NMI x 1		9 pins (Max), NMI x 1	12 pins (Max), NMI x 1
I/O port	24 pins (Max)		38 pins (Max)	54 pins (Max)
12-bit A/D converter	6 ch. (1 unit)		8 ch. (1 unit)	8 ch. (1 unit)
Smart Card Interface	No			1 ch (Max)
HDMI-CEC/ Remote Control Receiver	1 ch.(Max) Ch.1		2 ch (Max) Ch.0/1	

2.2 Packages

Package \ Package Suffix	B0A	C0A	D0A
LQFP: LQB032 (0.80 mm pitch)	❍	-	-
QFN: WNU032 (0.50 mm pitch)	❍	-	-
WLCSP: U4M030 (0.40 mm pitch)	❍		
LQFP: LQA048 (0.50 mm pitch)	-	❍	-
QFN: WNY048 (0.50 mm pitch)	-	❍	-
LQFP: LQD064 (0.50 mm pitch)	-	-	❍
QFN: WNS064 (0.50 mm pitch)	-	-	❍

❍: Available

Note:

- *See "14. Package Dimensions" for detailed information on each package.*

3. Product Features in Detail

32-bit ARM Cortex-M0+ Core

- Maximum operating frequency: 40.8 MHz
- Nested Vectored Interrupt Controller (NVIC): 1 NMI (non-maskable interrupt) and 24 peripheral interrupt with 4 selectable interrupt priority levels
- 24-bit System timer (Sys Tick): System timer for OS task management

Bit Band Operation

Compatible with Cortex-M3 bit band operation.

On-Chip Memory

- Flash memory
  - Up to 128 Kbytes
  - Read cycle: 0 wait-cycle
  - Security function for code protection
- SRAM

The on-chip SRAM of this series has one independent SRAM.

  - Up to 16 Kbytes
  - 4Kbytes: can retain value in Deep standby Mode

USB Interface

USB interface is composed of Device and Host
With Main PLL, USB clock can be generated by multiplication of Main clock.

- USB Device
  - USB 2.0 Full-Speed supported
  - Max 6 EndPoint supported
    - EndPoint 0 is control transfer
    - EndPoint 1, 2 can be selected Bulk-transfer, Interrupt-transfer or Isochronous-transfer
    - EndPoint 3 to 5 can select Bulk-transfer or Interrupt-transfer
    - EndPoint 1 to 5 comprise Double Buffer
    - The size of each EndPoint is according to the follows
    - EndPoint 0, 2 to 5 : 64 bytes
    - EndPoint 1 : 256 bytes
- USB host
  - USB 2.0 Full/Low-Speed supported
  - Bulk-transfer, Interrupt-transfer and Isochronous-transfer support
  - USB Device connected/disconnected automatically detect
  - IN/OUT token handshake packet automatically
  - Max 256-byte packet-length supported
  - Wake-up function supported

Multi-Function Serial Interface (Max 6channels)

- 3 channels with 64Byte FIFO (Ch.4, 6 and 7), 3 channels without FIFO (Ch.0, 1 and 3)
- The operation mode of each channel can be selected from one of the following.
  - UART
  - CSIO (CSIO is known to many customers as SPI)
  - I^2C
- UART
  - Full duplex double buffer
  - Parity can be enabled or disabled.
  - Built-in dedicated baud rate generator
  - External clock available as a serial clock
  - Hardware Flow control* : Automatically control the transmission by CTS/RTS (only ch.4)
    * : S6E1C32B0A/S6E1C31B0A and S6E1C32C0A/S6E1C31C0A do not support Hardware Flow control.
  - Various error detection functions (parity errors, framing errors, and overrun errors)
- CSIO (also known as SPI)
  - Full duplex double buffer
  - Built-in dedicated baud rate generator
  - Overrun error detection function
  - Serial chip select function (ch1 and ch6 only)
  - Data length: 5 to 16 bits
- I^2C
  - Standard-mode (Max: 100 kbps) supported / Fast-mode (Max 400 kbps) supported.
- I^2S (MFS-I2S)
  - Using CSIO (Max 2 ch: ch.4, ch.6) and I^2S clock generator
  - Supports two transfer protocol
    - I^2S
    - MSB-justified
  - Master mode only

Descriptor System Data Transfer Controller (DSTC) (64 Channels)

- The DSTC can transfer data at high-speed without going via the CPU. The DSTC adopts the Descriptor system and, following the specified contents of the Descriptor that has already been constructed on the memory, can access directly the memory / peripheral device and performs the data transfer operation.
- It supports the software activation, the hardware activation, and the chain activation functions

A/D Converter (Max: 8 Channels)

- 12-bit A/D Converter
  - Successive approximation type
  - Conversion time: 2.0 µs @ 2.7 V to 3.6 V
  - Priority conversion available (2 levels of priority)
  - Scan conversion mode
  - Built-in FIFO for conversion data storage (for scan conversion: 16 steps, for priority conversion: 4 steps)

Base Timer (Max: 8 Channels)

The operation mode of each channel can be selected from one of the following.

- 16-bit PWM timer
- 16-bit PPG timer
- 16/32-bit reload timer
- 16/32-bit PWC timer

General-Purpose I/O Port

This series can use its pin as a general-purpose I/O port when it is not used for an external bus or a peripheral function. All ports can be set to fast general-purpose I/O ports or slow general-purpose I/O ports. In addition, this series has a port relocate function that can set to which I/O port a peripheral function can be allocated.

- All ports are Fast GPIO which can be accessed by 1cycle
- Capable of controlling the pull-up of each pin
- Capable of reading pin level directly
- Port relocate function
- Up to 54 fast general-purpose I/O ports @64-pin package
- Certain ports are 5 V tolerant.
  See 5.List of Pin Functions and 6.I/O Circuit Type for the corresponding pins.

Dual Timer (32-/16-bit Down Counter)

The Dual Timer consists of two programmable 32-/16-bit down counters. The operation mode of each timer channel can be selected from one of the following.

- Free-running mode
- Periodic mode (= Reload mode)
- One-shot mode

Real-Time Clock

The Real-time Clock counts year/month/day/hour/minute/second/day of the week from year 00 to year 99.

- The RTC can generate an interrupt at a specific time (year/month/day/hour/minute) and can also generate an interrupt in a specific year, in a specific month, on a specific day, at a specific hour or at a specific minute.
- It has a timer interrupt function generating an interrupt upon a specific time or at specific intervals.
- It can keep counting while rewriting the time.
- It can count leap years automatically.

Watch Counter

The Watch Counter wakes up the microcontroller from the low power consumption mode. The clock source can be selected from the main clock, the sub clock, the built-in high-speed CR clock or the built-in low-speed CR clock.

Interval timer: up to 64 s (sub clock: 32.768 kHz)

External Interrupt Controller Unit

- Up to 12 external interrupt input pins
- Non-maskable interrupt (NMI) input pin: 1

Watchdog Timer (2 Channels)

The watchdog timer generates an interrupt or a reset when the counter reaches a time-out value.

This series consists of two different watchdogs, hardware watchdog and software watchdog.

The hardware watchdog timer is clocked by the built-in low-speed CR oscillator. Therefore, the hardware watchdog is active in any low-power consumption modes except RTC, Stop, Deep standby RTC and Deep standby Stop mode.

CRC (Cyclic Redundancy Check) Accelerator

The CRC accelerator calculates the CRC which has a heavy software processing load, and achieves a reduction of the integrity check processing load for reception data and storage.

- CCITT CRC16 and IEEE-802.3 CRC32 are supported.
  - CCITT CRC16 Generator Polynomial: 0x1021
  - IEEE-802.3 CRC32 Generator Polynomial: 0x04C11DB7

HDMI-CEC/Remote Control Receiver (Up to 2 Channels)

- HDMI-CEC transmitter
  - Header block automatic transmission by judging Signal free
  - Generating status interrupt by detecting Arbitration lost
  - Generating START, EOM, ACK automatically to output CEC transmission by setting 1 byte data
  - Generating transmission status interrupt when transmitting 1 block (1 byte data and EOM/ACK)
- HDMI-CEC receiver
  - Automatic ACK reply function available
  - Line error detection function available
- Remote control receiver
  - 4 bytes reception buffer
  - Repeat code detection function available

Smart Card Interface (Max 1 Channel)

- Compliant with ISO7816-3 specification
- Card Reader only/B class card only
- Available protocols
  - Transmitter: 8E2, 8O2, 8N2
  - Receiver: 8E1, 8O1, 8N2, 8N1, 9N1
  - Inverse mode
- TX/RX FIFO integrated (RX: 16-bytes, TX:16-bytes)

Clock and Reset

■Clocks
A clock can be selected from five clock sources (two external oscillators, two built-in CR oscillator, and main PLL).

- Main clock: 8 MHz to 48 MHz
- Sub clock: 32.768 kHz
- Built-in high-speed CR clock: 8 MHz
- Built-in low-speed CR clock: 100 kHz
- Main PLL clock 8MHz to 16MHz (Input), 75MHz to 150MHz (Output)

■Resets

- Reset request from the INITX pin
- Power on reset
- Software reset
- Watchdog timer reset
- Low-voltage detection reset
- Clock supervisor reset

Clock Supervisor (CSV)

The Clock Supervisor monitors the failure of external clocks with a clock generated by a built-in CR oscillator.

■If an external clock failure (clock stop) is detected, a reset is asserted.

■If an external frequency anomaly is detected, an interrupt or a reset is asserted.

Low-Voltage Detector (LVD)

This series monitors the voltage on the VCC pin with a 2-stage mechanism. When the voltage falls below a designated voltage, the Low-voltage Detector generates an interrupt or a reset.

■LVD1: monitor V_{CC} and error reporting via an interrupt

■LVD2: auto-reset operation

Low Power Consumption Mode

This series has six low power consumption modes.

■Sleep

■Timer

■RTC

■Stop

■Deep standby RTC (selectable between keeping the value of RAM and not)

■Deep standby Stop (selectable between keeping the value of RAM and not)

Peripheral Clock Gating

The system can reduce the current consumption of the total system with gating the operation clocks of peripheral functions not used.

Debug

■Serial Wire Debug Port (SW-DP)

■Micro Trace Buffer (MTB)

Unique ID

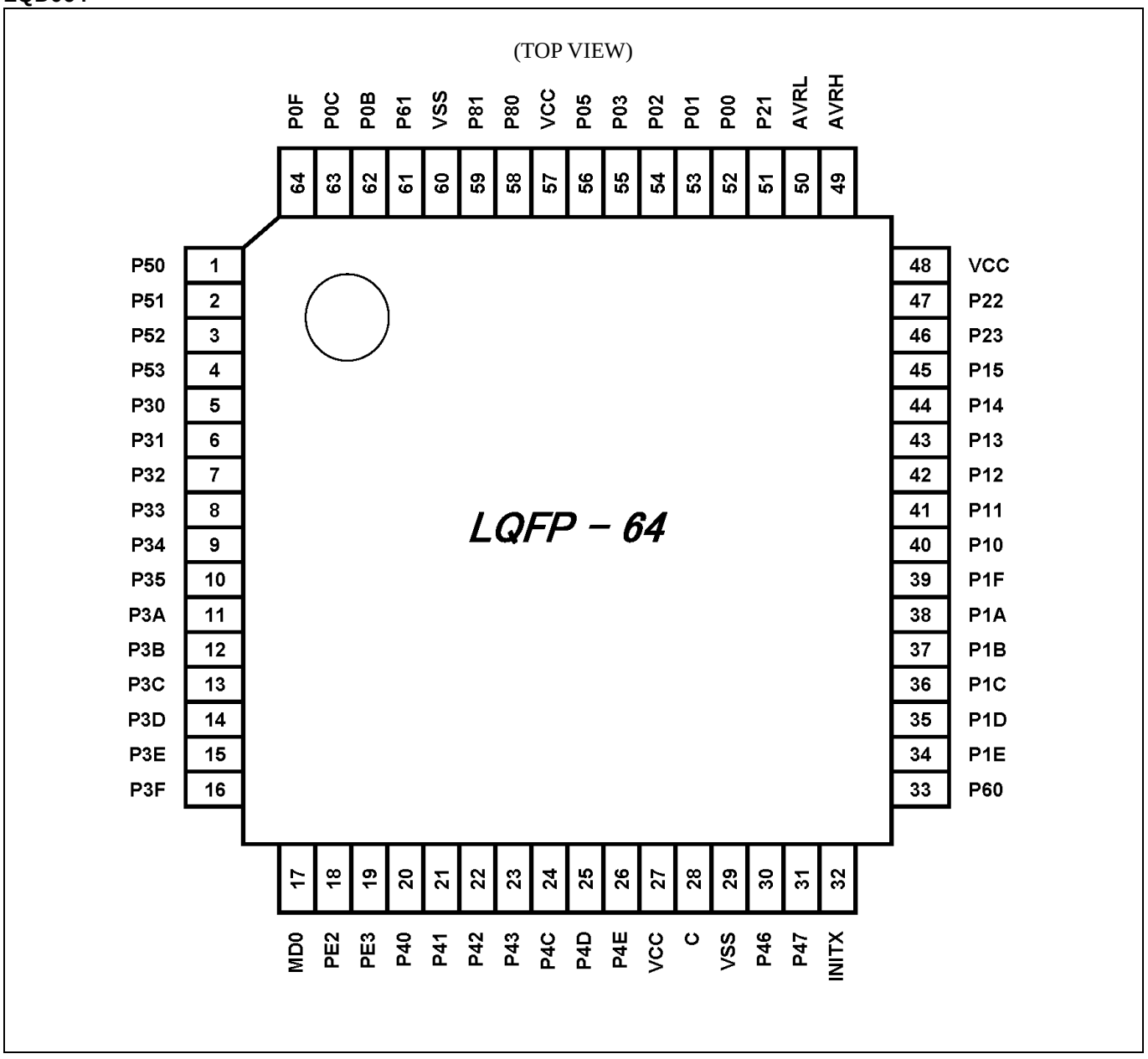
A 41-bit unique value of the device has been set.

Power Supply

■Wide voltage range:
VCC = 1.65V to 3.6 V
VCC = 3.0V to 3.6V (when USB is used)

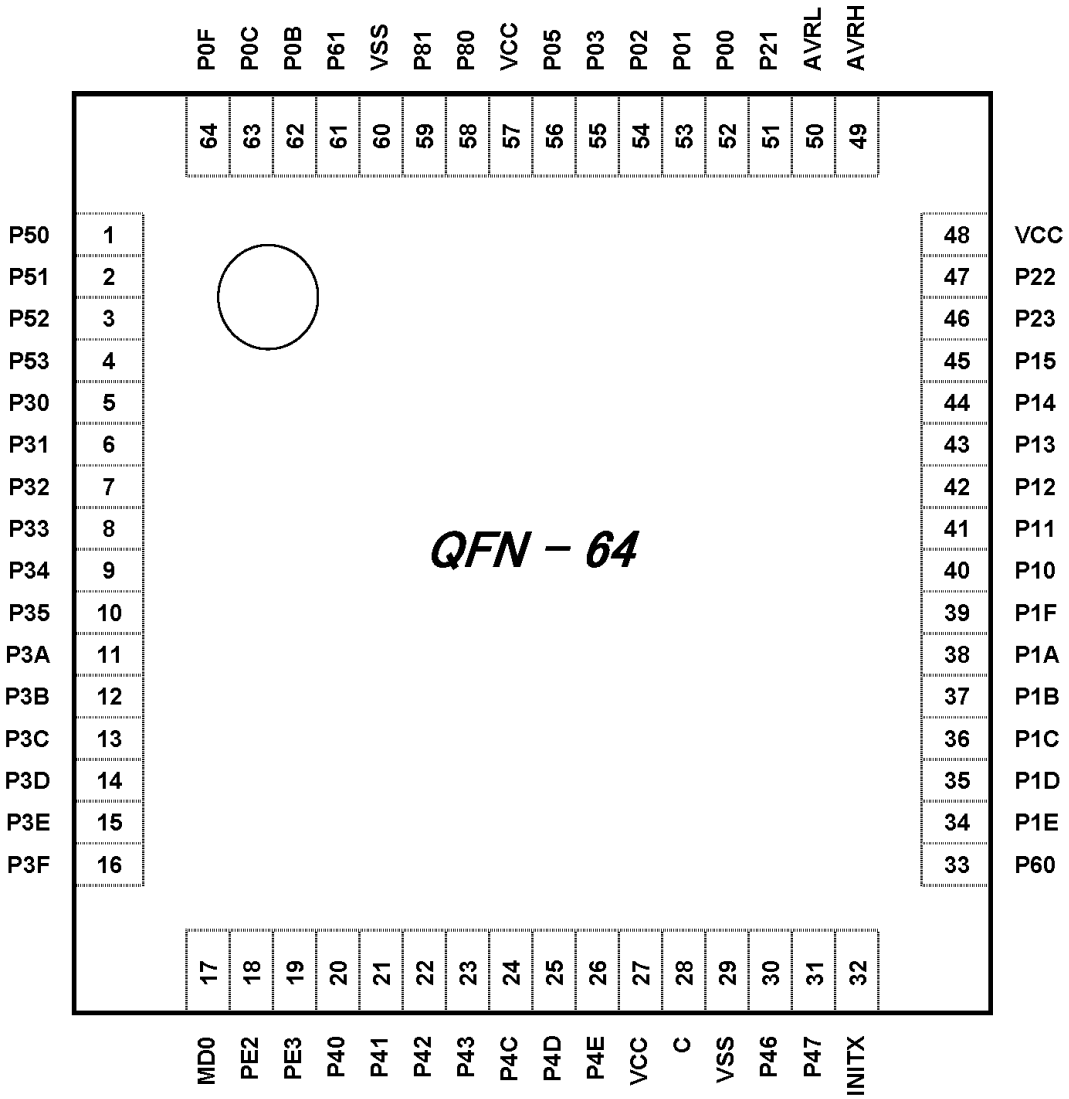
4. Pin Assignment

LQD064



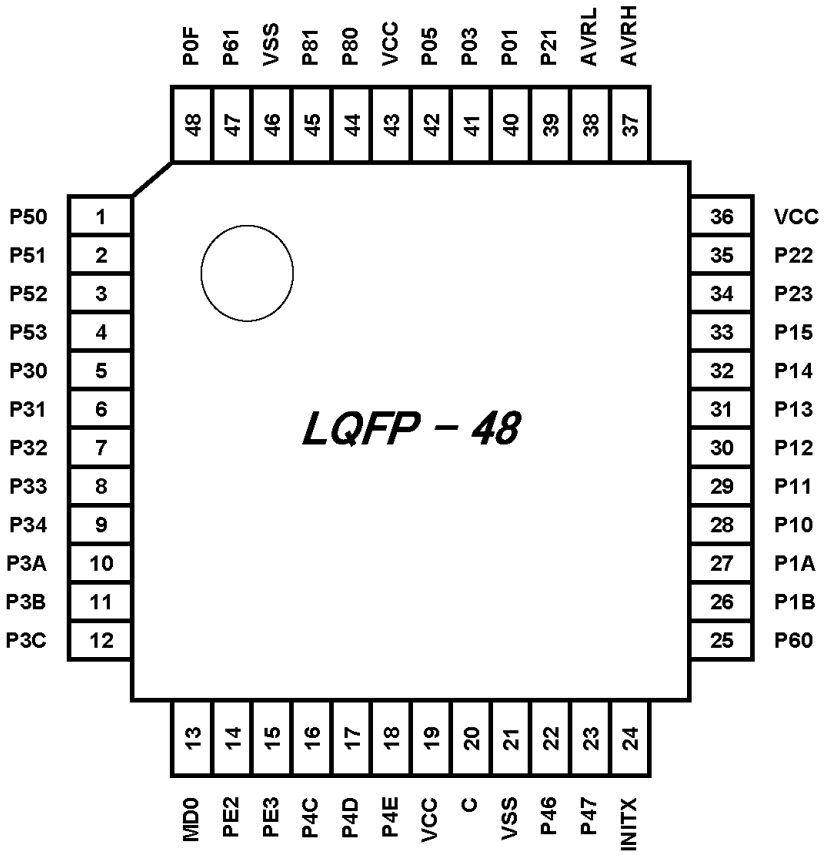
WNS064

(TOP VIEW)



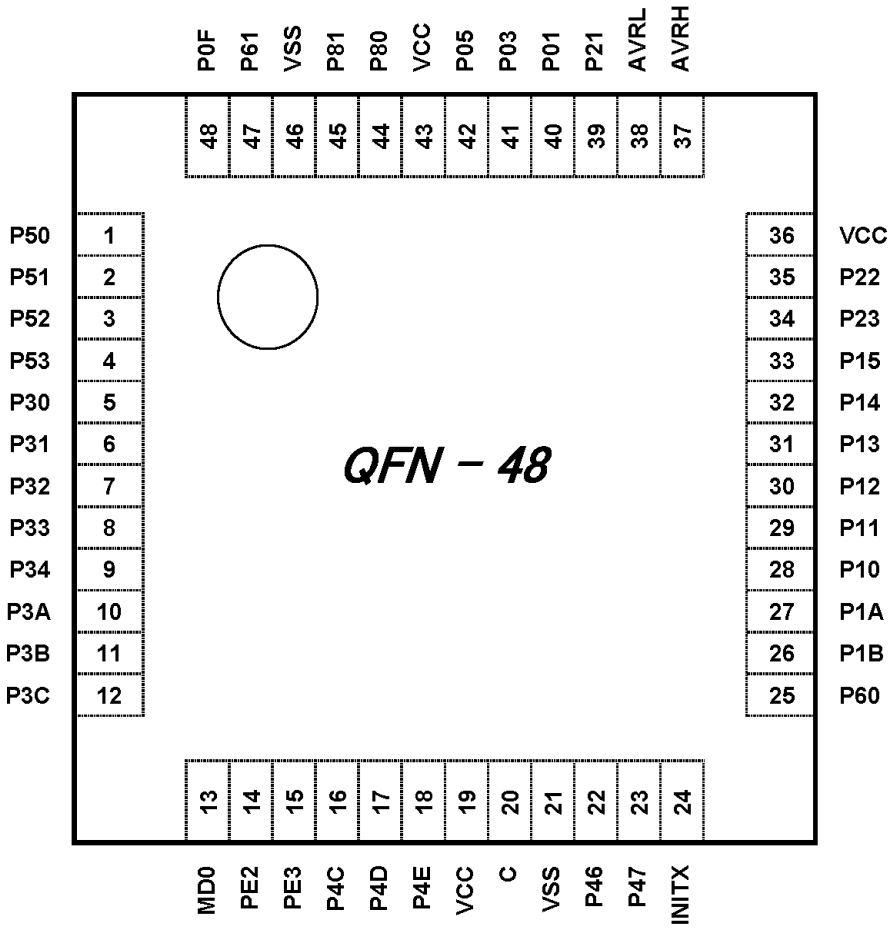
LQA048

(TOP VIEW)

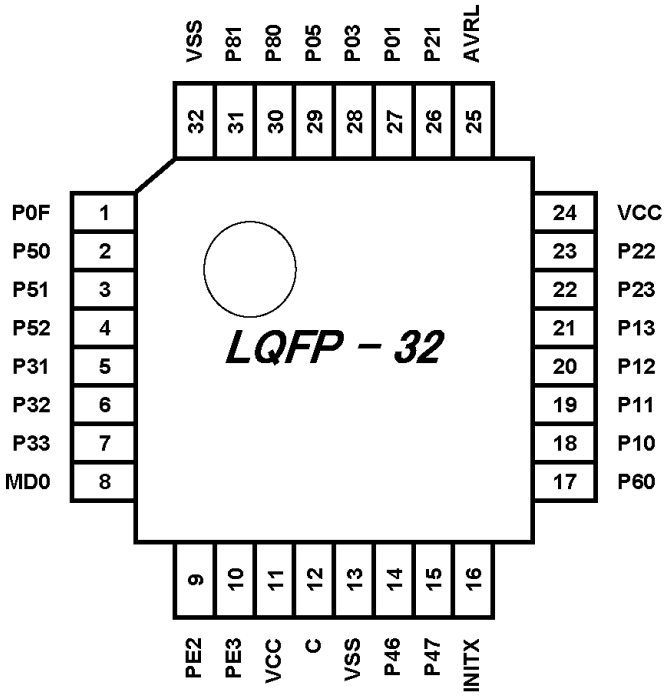


WNY048

(TOP VIEW)

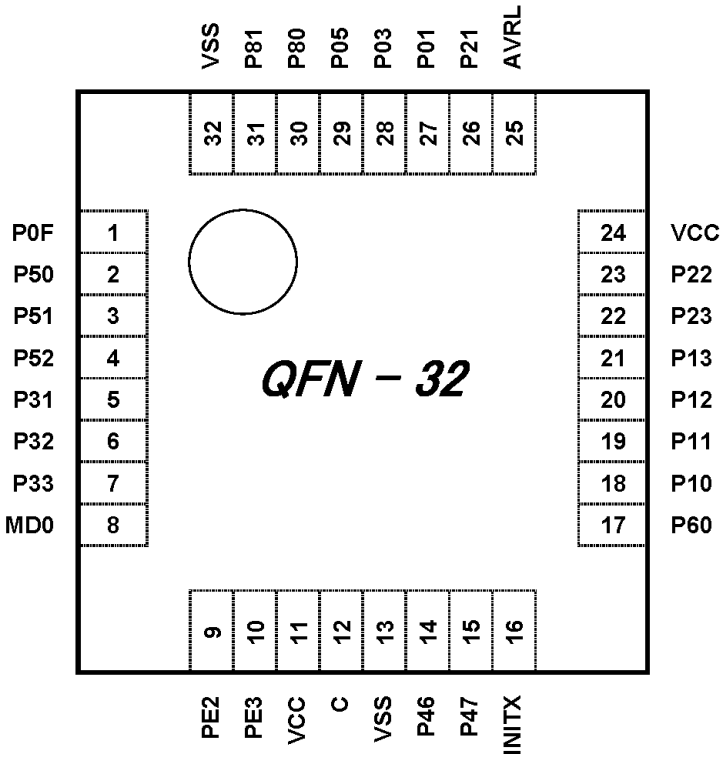


LQB032

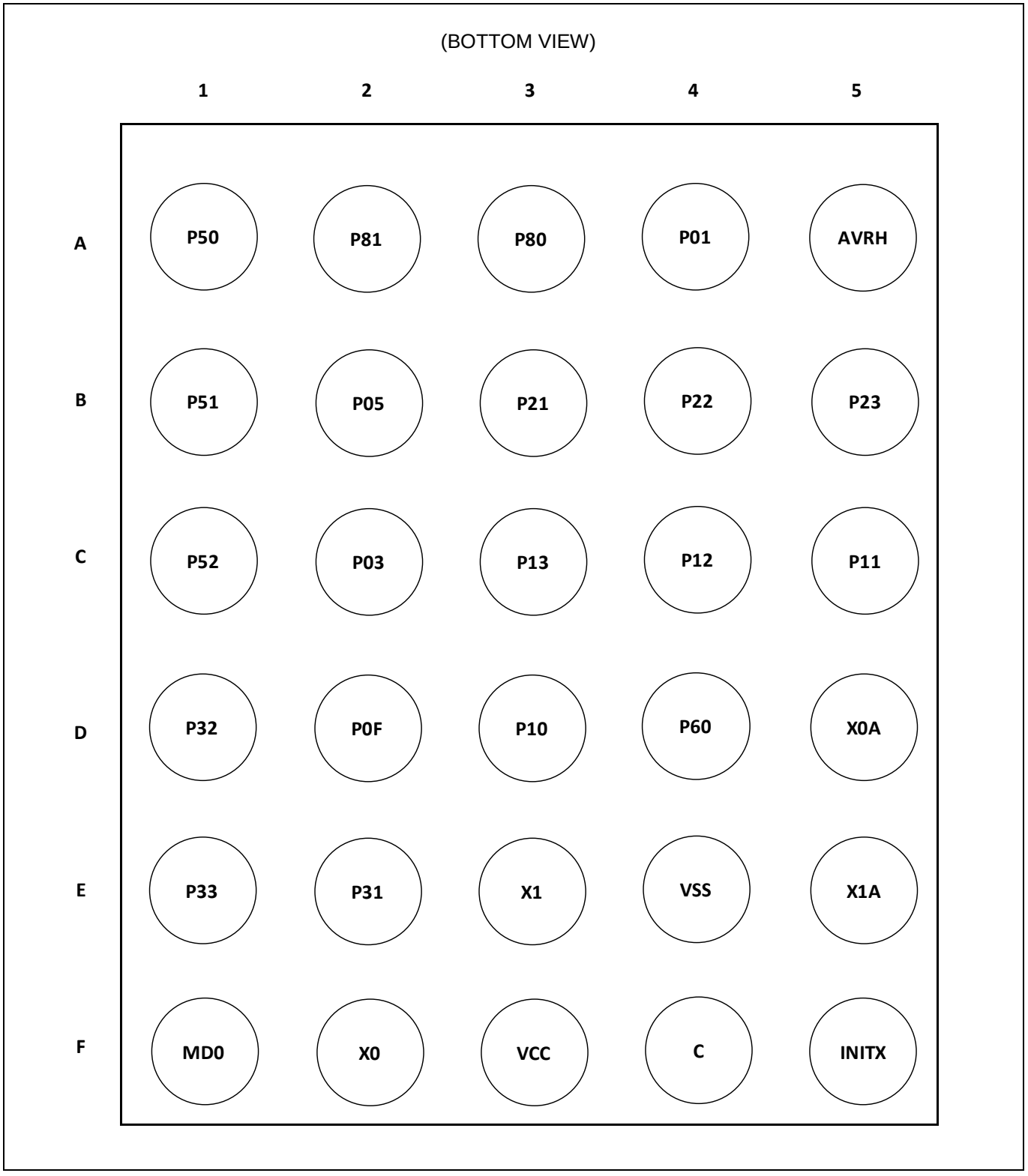

(TOP VIEW)
VSS
P81
P80
P05
P03
P01
P21
AVRL
32
31
30
29
28
27
26
25
P0F
P50
P51
P52
P31
P32
P33
MD0
1
2
3
4
5
6
7
8
LQFP – 32
24
23
22
21
20
19
18
17
VCC
P22
P23
P13
P12
P11
P10
P60
9
10
11
12
13
14
15
16
PE2
PE3
VCC
C
VSS
P46
P47
INITX

WNU032

(TOP VIEW)



U4M030


(BOTTOM VIEW)
1
2
3
4
5
A
B
C
D
E
F
P50
P81
P80
P01
AVRH
P51
P05
P21
P22
P23
P52
P03
P13
P12
P11
P32
P0F
P10
P60
X0A
P33
P31
X1
VSS
X1A
MD0
X0
VCC
C
INITX

5. List of Pin Functions

List of Pin Numbers

The number after the underscore ("_") in a pin name such as XXX_1 and XXX_2 indicates the relocated port number. The channel on such pin has multiple functions, each of which has its own pin name. Use the Extended Port Function Register (EPFR) to select the pin to be used.

Pin No.				Pin Name	Alternate Functions					I/O Circuit Type	Pin State Type
LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32	WLCSP-30								
1	1	2	A1	P50	SIN3_1	INT00_0				D	K
2	2	3	B1	P51	SOT3_1	INT01_0				D	K
3	3	4	C1	P52	SCK3_1	INT02_0				D	K
4	4	-	-	P53	TIOA1_2	INT07_2				D	K
5	5	-	-	P30	SCS60_1	TIOB0_1	INT03_2	MI2SWS6_1		D	K
6	6	-	-	P31	SCK6_1	INT04_2	MI2SCK6_1			H	K
-	-	5	E2	P31	SCK6_1	INT04_2				H	K
7	7	-	-	P32	SOT6_1	TIOB2_1	INT05_2	MI2SDO6_1		H	K
-	-	6	D1	P32	SOT6_1	TIOB2_1	INT05_2			H	K
8	8	-	-	P33	ADTG_6	SIN6_1	INT04_0	MI2SDI6_1		H	K
-	-	7	E1	P33	ADTG_6	SIN6_1	INT04_0			H	K
9	-	-	-	P34	SCS61_1	TIOB4_1	MI2SMCK6_1			D	K
-	9	-	-	P34	SCS61_1	MI2SMCK6_1				D	K
10	-	-	-	P35	SCS62_1	TIOB5_1	INT08_1			D	K
11	-	-	-	P3A	TIOA0_1	INT03_0	RTCCO_2	SUBOUT_2	IC1_CIN_0	D	K
-	10	-	-	P3A	TIOA0_1	INT03_0	RTCCO_2	SUBOUT_2		D	K
12	-	-	-	P3B	TIOA1_1	IC1_DATA_0				D	K
-	11	-	-	P3B	TIOA1_1					D	K
13	-	-	-	P3C	TIOA2_1	IC1_RST_0				D	K
-	12	-	-	P3C	TIOA2_1					D	K
14	-	-	-	P3D	TIOA3_1	IC1_VPEN_0				D	K
15	-	-	-	P3E	TIOA4_1	IC1_VCC_0				D	K
16	-	-	-	P3F	TIOA5_1	IC1_CLK_0				D	K
17	13	8	F1	MD0						I	F
18	14	9	F2	PE2	X0					A	A
19	15	10	E3	PE3	X1					A	B
20	-	-	-	P40	TIOA0_0	INT12_1				D	K
21	-	-	-	P41	TIOA1_0	INT13_1				D	K
22	-	-	-	P42	TIOA2_0					D	K
23	-	-	-	P43	ADTG_7	TIOA3_0				D	K
24	-	-	-	P4C	SCK7_1	TIOB3_0				D	K
-	16	-	-	P4C	SCK7_1					D	K
25	17	-	-	P4D	SOT7_1					D	K
26	18	-	-	P4E	SIN7_1	INT06_2				D	K
27	19	11	F3	VCC						-	-
28	20	12	F4	C						-	-
29	21	13	E4	VSS						-	-
30	22	14	D5	P46	X0A					C	C

Pin No.				Pin Name	Alternate Functions					I/O Circuit Type	Pin State Type
LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32	WLCSP-30								
31	23	15	E5	P47	X1A					C	D
32	24	16	F5	INITX						B	E
33	25	17	D4	P60	TIOA2_2	INT15_1	CEC1_0			H	K
34	-	-	-	P1E	RTS4_1	MI2SMCK4_1				D	K
35	-	-	-	P1D	CTS4_1	MI2SWS4_1				D	K
36	-	-	-	P1C	SCK4_1	MI2SCK4_1				D	K
37	-	-	-	P1B	SOT4_1	MI2SDO4_1				D	K
-	26	-	-	P1B	SOT4_1					D	K
38	-	-	-	P1A	SIN4_1	INT05_1	CEC0_0	MI2SDI4_1		H	K
-	27	-	-	P1A	SIN4_1	INT05_1	CEC0_0			H	K
39	-	-	-	P1F	ADTG_5					D	K
40	28	18	D3	P10	AN00					F	J
41	29	19	C5	P11	AN01	SIN1_1	INT02_1	WKUP1		G	J
42	30	20	C4	P12	AN02	SOT1_1				F	J
43	31	21	C3	P13	AN03	SCK1_1	RTCCO_1	SUBOUT_1		F	J
44	32	-	-	P14	AN04	SIN0_1	SCS10_1	INT03_1		F	J
45	33	-	-	P15	AN05	SOT0_1	SCS11_1			F	J
46	34	22	B5	P23	AN06	SCK0_0	TIOA7_1			F	J
47	35	23	B4	P22	AN07	TIOB7_1				F	J
48	36	24	A5	VCC						-	-
49	37	-	-	AVRH[1]						-	-
50	38	25	-	AVRL						-	-
51	39	26	B3	P21	INT06_1	WKUP2				E	K
52	-	-	-	P00	WKUP4					E	K
53	40	27	A4	P01	SWCLK	SOT0_0				D	K
54	-	-	-	P02	WKUP5					E	K
55	41	28	C2	P03	SWDIO	SIN0_0	TIOB7_0			D	K
56	42	29	B2	P05	MD1	TIOA5_2	INT00_1	WKUP3		E	K
57	43	-	-	VCC						-	-
58	44	30	A3	P80	UDM0					J	G
59	45	31	A2	P81	UDP0					J	G
60	46	32	-	VSS						-	-
61	47	-	-	P61	UHCONX0	TIOB2_2				H	K
62	-	-	-	P0B	TIOB6_1	WKUP6				E	K
63	-	-	-	P0C	TIOA6_1	WKUP7				E	K
64	48	1	D2	P0F	NMIX	WKUP0	RTCCO_0	SUBOUT_0	CROUT_1	E	I

[1] In a 32-pin package, the AVRH pin is internally connected to the V_{CC} pin.

List of Pin Functions

The number after the underscore ("_") in a function name such as XXX_1 and XXX_2 indicates one of the relocate options to route that function to a different pin. Use the Extended Port Function Register (EPFR) to disable or select the desired relocate option.

Pin Function	Pin Name	Function Description	Pin No.			
			LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32	WLCSP-30
ADC	ADTG_5	A/D converter external trigger input pin	39	-	-	-
	ADTG_6		8	8	7	E1
	ADTG_7		23	-	-	-
ADC	AN00	A/D converter analog input pin. ANxx describes ADC ch.xx.	40	28	18	D3
	AN01		41	29	19	C5
	AN02		42	30	20	C4
	AN03		43	31	21	C3
	AN04		44	32	-	-
	AN05		45	33	-	-
	AN06		46	34	22	B5
	AN07		47	35	23	B4
Base Timer 0	TIOA0_0	Base timer ch.0 TIOA pin	20	-	-	-
	TIOA0_1		11	10	-	-
	TIOB0_1	Base timer ch.0 TIOB pin	5	5	-	-
Base Timer 1	TIOA1_0	Base timer ch.1 TIOA pin	21	-	-	-
	TIOA1_1		12	11	-	-
	TIOA1_2		4	4	-	-
Base Timer 2	TIOA2_0	Base timer ch.2 TIOA pin	22	-	-	-
	TIOA2_1		13	12	-	-
	TIOA2_2		33	25	17	D4
	TIOB2_1	Base timer ch.2 TIOB pin	7	7	6	D1
	TIOB2_2		61	47	-	-
Base Timer 3	TIOA3_0	Base timer ch.3 TIOA pin	23	-	-	-
	TIOA3_1		14	-	-	-
	TIOB3_0	Base timer ch.3 TIOB pin	24	-	-	-
Base Timer 4	TIOA4_1	Base timer ch.4 TIOA pin	15	-	-	-
	TIOB4_1	Base timer ch.4 TIOB pin	9	-	-	-
Base Timer 5	TIOA5_1	Base timer ch.5 TIOA pin	16	-	-	-
	TIOA5_2		56	42	29	B2
	TIOB5_1	Base timer ch.5 TIOB pin	10	-	-	-
Base Timer 6	TIOA6_1	Base timer ch.6 TIOA pin	63	-	-	-
	TIOB6_1	Base timer ch.6 TIOB pin	62	-	-	-
Base Timer 7	TIOA7_1	Base timer ch.7 TIOA pin	46	34	22	B5
	TIOB7_0	Base timer ch.7 TIOB pin	55	41	28	C2
	TIOB7_1		47	35	23	B4
Debugger	SWCLK	Serial wire debug interface clock input pin	53	40	27	A4
	SWDIO	Serial wire debug interface data input / output pin	55	41	28	C2

Pin Function	Pin Name	Function Description	Pin No.			
			LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32	WLCSP-30
External Interrupt	INT00_0	External interrupt request 00 input pin	1	1	2	A1
	INT00_1		56	42	29	B2
	INT01_0	External interrupt request 01 input pin	2	2	3	B1
	INT02_0	External interrupt request 02 input pin	3	3	4	C1
	INT02_1		41	29	19	C5
	INT03_0	External interrupt request 03 input pin	11	10	-	-
	INT03_1		44	32	-	-
	INT03_2		5	5	-	-
	INT04_0	External interrupt request 04 input pin	8	8	7	E1
	INT04_2		6	6	5	E2
	INT05_1	External interrupt request 05 input pin	38	27	-	-
	INT05_2		7	7	6	D1
	INT06_1	External interrupt request 06 input pin	51	39	26	B3
	INT06_2		26	18	-	-
	INT07_2	External interrupt request 07 input pin	4	4	-	-
	INT08_1	External interrupt request 08 input pin	10	-	-	-
	INT12_1	External interrupt request 12 input pin	20	-	-	-
	INT13_1	External interrupt request 13 input pin	21	-	-	-
	INT15_1	External interrupt request 15 input pin	33	25	17	D4
	NMIX	Non-Maskable Interrupt input pin	64	48	1	D2
GPIO	P00	General-purpose I/O port 0	52	-	-	-
	P01		53	40	27	A4
	P02		54	-	-	-
	P03		55	41	28	C2
	P05		56	42	29	B2
	P0B		62	-	-	-
	P0C		63	-	-	-
	P0F		64	48	1	D2
GPIO	P10	General-purpose I/O port 1	40	28	18	D3
	P11		41	29	19	C5
	P12		42	30	20	C4
	P13		43	31	21	C3
	P14		44	32	-	-
	P15		45	33	-	-
	P1A		38	27	-	-
	P1B		37	26	-	
	P1C		36	-	-	-
	P1D		35	-	-	-
	P1E		34	-	-	-
	P1F		39	-	-	-
GPIO	P21	General-purpose I/O port 2	51	39	26	B3
	P22		47	35	23	B4
	P23		46	34	22	B5

Pin Function	Pin Name	Function Description	Pin No.			
			LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32	WLCSP-30
GPIO	P30	General-purpose I/O port 3	5	5	-	-
	P31		6	6	5	E2
	P32		7	7	6	D1
	P33		8	8	7	E1
	P34		9	9	-	-
	P35		10	-	-	-
	P3A		11	10	-	-
	P3B		12	11	-	-
	P3C		13	12	-	-
	P3D		14	-	-	-
	P3E		15	-	-	-
	P3F		16	-	-	-
GPIO	P40	General-purpose I/O port 4	20	-	-	-
	P41		21	-	-	-
	P42		22	-	-	-
	P43		23	-	-	-
	P46		30	22	14	D5
	P47		31	23	15	E5
	P4C		24	16	-	-
	P4D		25	17	-	-
	P4E		26	18	-	-
GPIO	P50	General-purpose I/O port 5	1	1	2	A1
	P51		2	2	3	B1
	P52		3	3	4	C1
	P53		4	4	-	-
GPIO	P60	General-purpose I/O port 6	33	25	17	D4
	P61		61	47	-	-
GPIO	P80	General-purpose I/O port 8	58	44	30	A3
	P81		59	45	31	A2
GPIO	PE2	General-purpose I/O port E	18	14	9	F2
	PE3		19	15	10	E3
Multi-function Serial 0	SIN0_0	Multi-function serial interface ch.0 input pin	55	41	28	C2
	SIN0_1		44	32	-	-
	SOT0_0 (SDA0_0)	Multi-function serial interface ch.0 output pin. This pin operates as SOT0 when used as a UART/CSIO/LIN pin (operation mode 0 to 3) and as SDA0 when used as an I^2C pin (operation mode 4).	53	40	27	A4
	SOT0_1 (SDA0_1)		45	33	-	-
	SCK0_0 (SCL0_0)	Multi-function serial interface ch.0 clock I/O pin. This pin operates as SCK0 when used as a CSIO pin (operation mode 2) and as SCL0 when used as an I^2C pin (operation mode 4).	46	34	22	B5

Pin Function	Pin Name	Function Description	Pin No.			
			LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32	WLCSP-30
Multi-function Serial 1	SIN1_1	Multi-function serial interface ch.1 input pin	41	29	19	C5
	SOT1_1 (SDA1_1)	Multi-function serial interface ch.1 output pin. This pin operates as SOT1 when used as a UART/CSIO/LIN pin (operation mode 0 to 3) and as SDA1 when used as an I^2C pin (operation mode 4).	42	30	20	C4
	SCK1_1 (SCL1_1)	Multi-function serial interface ch.1 clock I/O pin. This pin operates as SCK1 when used as a CSIO pin (operation mode 2) and as SCL1 when used as an I^2C pin (operation mode 4).	43	31	21	C3
	SCS10_1	Multi-function serial interface ch.1 serial chip select 0 input/output pin.	44	32	-	-
	SCS11_1	Multi-function serial interface ch.1 serial chip select 1 output pin.	45	33	-	-
Multi-function Serial 3	SIN3_1	Multi-function serial interface ch.3 input pin	1	1	2	A1
	SOT3_1 (SDA3_1)	Multi-function serial interface ch.3 output pin. This pin operates as SOT3 when used as a UART/CSIO/LIN pin (operation mode 0 to 3) and as SDA3 when used as an I^2C pin (operation mode 4).	2	2	3	B1
	SCK3_1 (SCL3_1)	Multi-function serial interface ch.3 clock I/O pin. This pin operates as SCK3 when used as a CSIO (operation mode 2) and as SCL3 when used as an I^2C pin (operation mode 4).	3	3	4	C1
Multi-function Serial 4	SIN4_1	Multi-function serial interface ch.4 input pin	38	27	-	-
	SOT4_1 (SDA4_1)	Multi-function serial interface ch.4 output pin. This pin operates as SOT4 when used as a UART/CSIO/LIN pin (operation mode 0 to 3) and as SDA4 when used as an I^2C pin (operation mode 4).	37	26	-	-
	SCK4_1 (SCL4_1)	Multi-function serial interface ch.4 clock I/O pin. This pin operates as SCK4 when used as a CSIO (operation mode 2) and as SCL4 when used as an I^2C pin (operation mode 4).	36	-	-	-
	CTS4_1	Multi-function serial interface ch4 CTS input pin	35	-	-	-
	RTS4_1	Multi-function serial interface ch4 RTS output pin	34	-	-	-

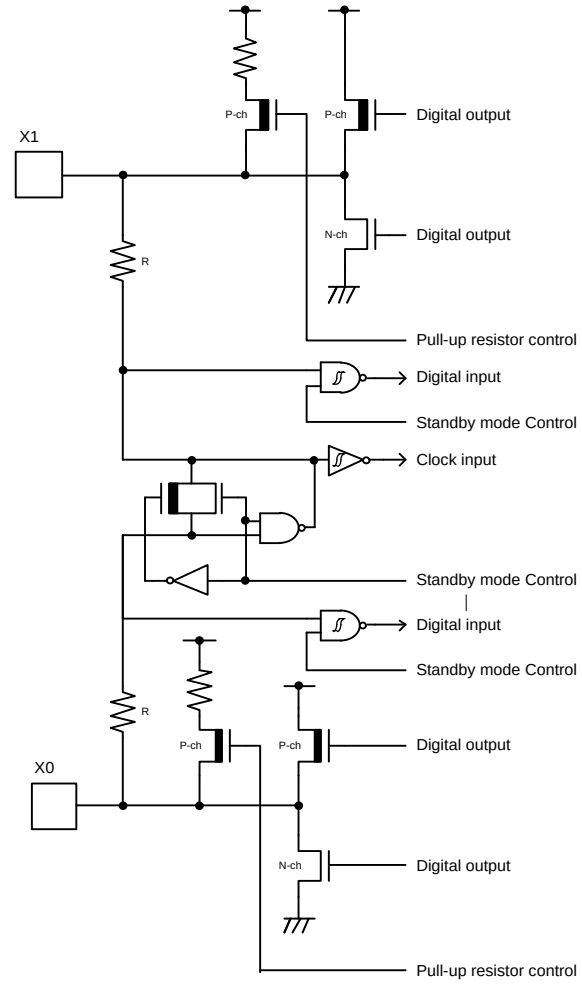
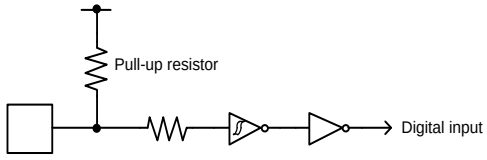
Pin Function	Pin Name	Function Description	Pin No.			
			LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32	WLCSP-30
Multi-function Serial 6	SIN6_1	Multi-function serial interface ch.6 input pin	8	8	7	E1
	SOT6_1 (SDA6_1)	Multi-function serial interface ch.6 output pin. This pin operates as SOT6 when used as a UART/CSIO/LIN pin (operation mode 0 to 3) and as SDA6 when used as an I^2C pin (operation mode 4).	7	7	6	D1
	SCK6_1 (SCL6_1)	Multi-function serial interface ch.6 clock I/O pin. This pin operates as SCK6 when used as a CSIO (operation mode 2) and as SCL6 when used as an I^2C pin (operation mode 4).	6	6	5	E2
	SCS60_1	Multi-function serial interface ch.6 serial chip select 0 input/output pin.	5	5	-	-
	SCS61_1	Multi-function serial interface ch.6 serial chip select 1 output pin.	9	9	-	-
	SCS62_1	Multi-function serial interface ch.6 serial chip select 2 output pin.	10	-	-	-
Multi-function Serial 7	SIN7_1	Multi-function serial interface ch.7 input pin	26	18	-	-
	SOT7_1 (SDA7_1)	Multi-function serial interface ch.7 output pin. This pin operates as SOT7 when used as a UART/CSIO/LIN pin (operation mode 0 to 3) and as SDA7 when used as an I^2C pin (operation mode 4).	25	17	-	-
	SCK7_1 (SCL7_1)	Multi-function serial interface ch.7 clock I/O pin. This pin operates as SCK7 when used as a CSIO (operation mode 2) and as SCL7 when used as an I^2C pin (operation mode 4).	24	16	-	-

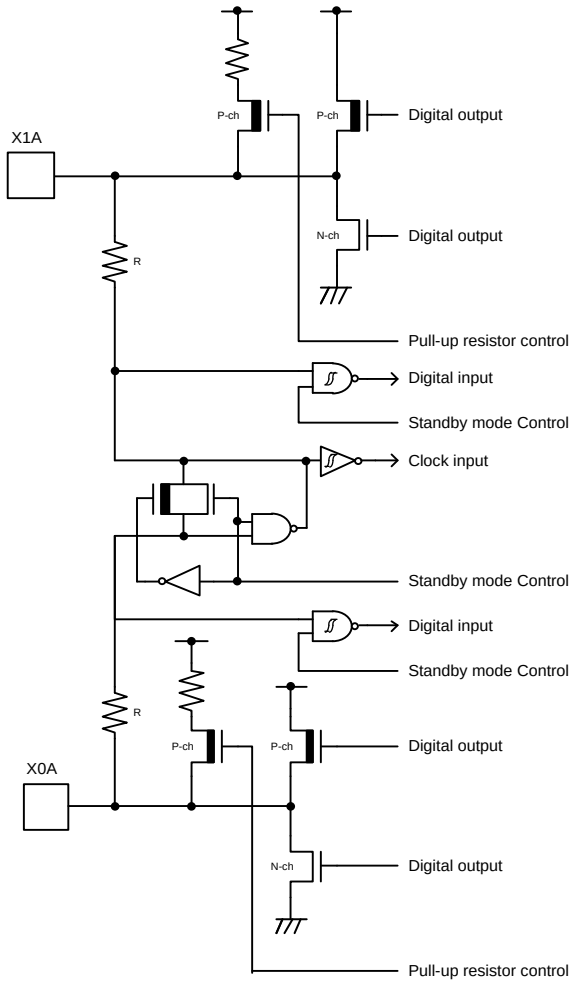
Pin Function	Pin Name	Function Description	Pin No.			
			LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32	WLCSP-30
I2S(MFS)	MI2SDI4_1	I²S Serial Data Input pin (operation mode 2).	38	-	-	-
	MI2SDO4_1	I²S Serial Data Output pin (operation mode 2).	37	-	-	-
	MI2SCK4_1	I²S Serial Clock Output pin (operation mode 2).	36	-	-	-
	MI2SWS4_1	I²S Word Select Output pin (operation mode 2).	35	-	-	-
	MI2SMCK4_1	I²S Master Clock Input/output pin (operation mode 2).	34	-	-	-
	MI2SDI6_1	I²S Serial Data Input pin (operation mode 2).	8	8	-	-
	MI2SDO6_1	I²S Serial Data Output pin (operation mode 2).	7	7	-	-
	MI2SCK6_1	I²S Serial Clock Output pin (operation mode 2).	6	6	-	-
	MI2SWS6_1	I²S Word Select Output pin (operation mode 2).	5	5	-	-
	MI2SMCK6_1	I²S Master Clock Input/output pin (operation mode 2).	9	9	-	-
Smart Card Interface	IC1_CIN_0	Smart Card insert detection output pin	11	-	-	-
	IC1_CLK_0	Smart Card serial interface clock output pin	16	-	-	-
	IC1_DATA_0	Smart Card serial interface data input pin	12	-	-	-
	IC1_RST_0	Smart Card reset output pin	13	-	-	-
	IC1_VCC_0	Smart Card power enable output pin	15	-	-	-
	IC1_VPEN_0	Smart Card programming output pin	14	-	-	-
USB	UDM0	USB function/host D – pin	58	44	30	A3
	UDP0	USB function/host D + pin	59	45	31	A2
	UHCONX0	USB external pull-up control pin	61	47	-	-
Real-time Clock	RTCCO_0	0.5 seconds pulse output pin of real-time clock	64	48	1	D2
	RTCCO_1		43	31	21	C3
	RTCCO_2		11	10	-	-
	SUBOUT_0	Sub clock output pin	64	48	1	D2
	SUBOUT_1		43	31	21	C3
	SUBOUT_2		11	10	-	-
HDMI-CEC/Remote Control Reception	CEC0_0	HDMI-CEC/Remote Control Reception ch.0 input/output pin	38	27	-	-
	CEC1_0	HDMI-CEC/Remote Control Reception ch.1 input/output pin	33	25	17	D4

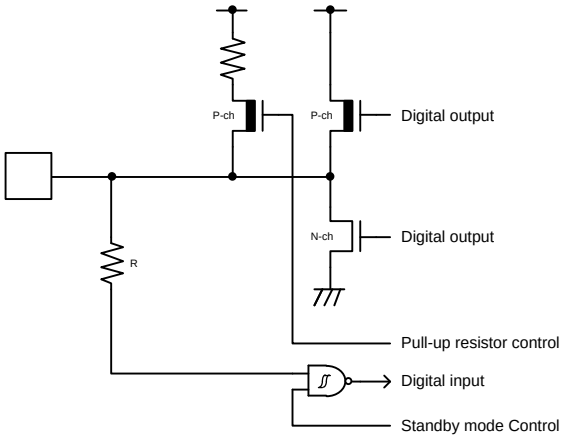
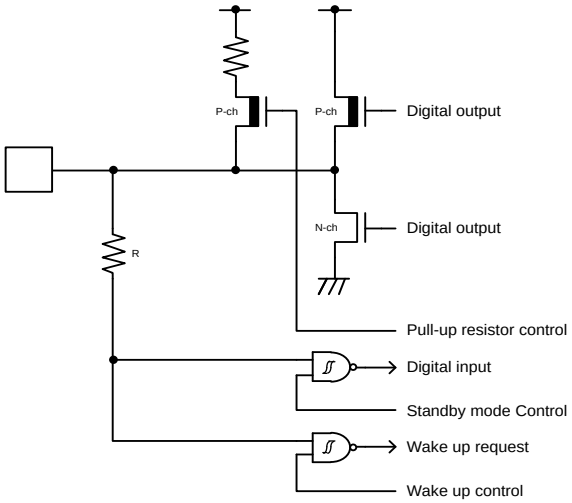
Pin Function	Pin Name	Function Description	Pin No.			
			LQFP-64 QFN-64	LQFP-48 QFN-48	LQFP-32 QFN-32	WLCSP-30
Low Power Consumption Mode	WKUP0	Deep Standby mode return signal input pin 0	64	48	1	D2
	WKUP1	Deep Standby mode return signal input pin 1	41	29	19	C5
	WKUP2	Deep Standby mode return signal input pin 2	51	39	26	B3
	WKUP3	Deep Standby mode return signal input pin 3	56	42	29	B2
	WKUP4	Deep Standby mode return signal input pin 4	52	-	-	-
	WKUP5	Deep Standby mode return signal input pin 5	54	-	-	-
	WKUP6	Deep Standby mode return signal input pin 6	62	-	-	-
	WKUP7	Deep Standby mode return signal input pin 7	63	-	-	-
RESET	INITX	External Reset Input pin. A reset is valid when INITX="L".	32	24	16	F5
MODE	MD0	Mode 0 pin. During normal operation, input MD0="L". During serial programming to Flash memory, input MD0="H".	17	13	8	F1
	MD1	Mode 1 pin. During normal operation, input is not needed. During serial programming to Flash memory, MD1 = "L" must be input.	56	42	29	B2
CLOCK	X0	Main clock (oscillation) input pin	18	14	9	F2
	X0A	Sub clock (oscillation) input pin	30	22	14	D5
	X1	Main clock (oscillation) I/O pin	19	15	10	E3
	X1A	Sub clock (oscillation) I/O pin	31	23	15	E5
	CROUT_1	Built-in high-speed CR oscillation clock output port	64	48	1	D2
POWER	VCC	Power supply pin	27	19	11	F3
	VCC		48	36	24	A5
	VCC		57	43	-	-
GND	VSS	GND pin	29	21	13	E4
	VSS		60	46	32	-
Analog Reference	AVRH[2]	A/D converter analog reference voltage input pin	49	37	-	-
	AVRL	A/D converter analog reference voltage input pin	50	38	25	-
C pin	C	Power supply stabilization capacitance pin	28	20	12	F4

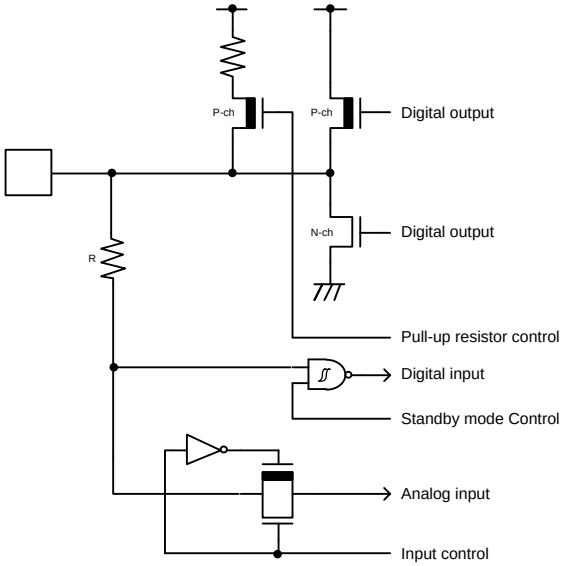
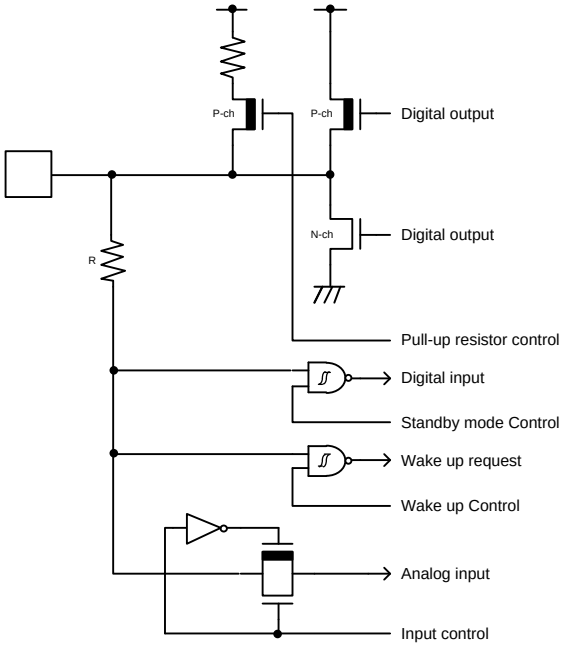
[2] In case of 32-pin package, AVRH pin is internally connected to the V_{CC} pin.

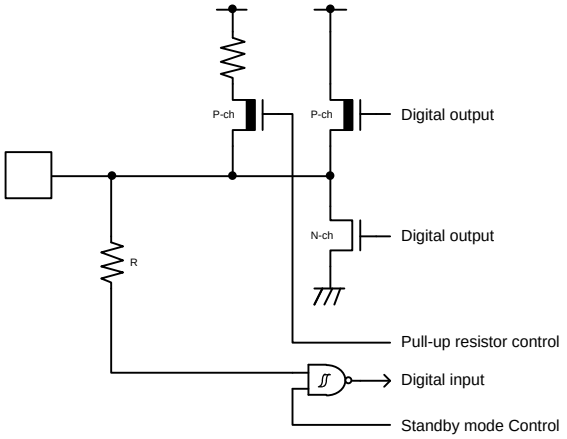
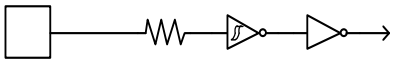
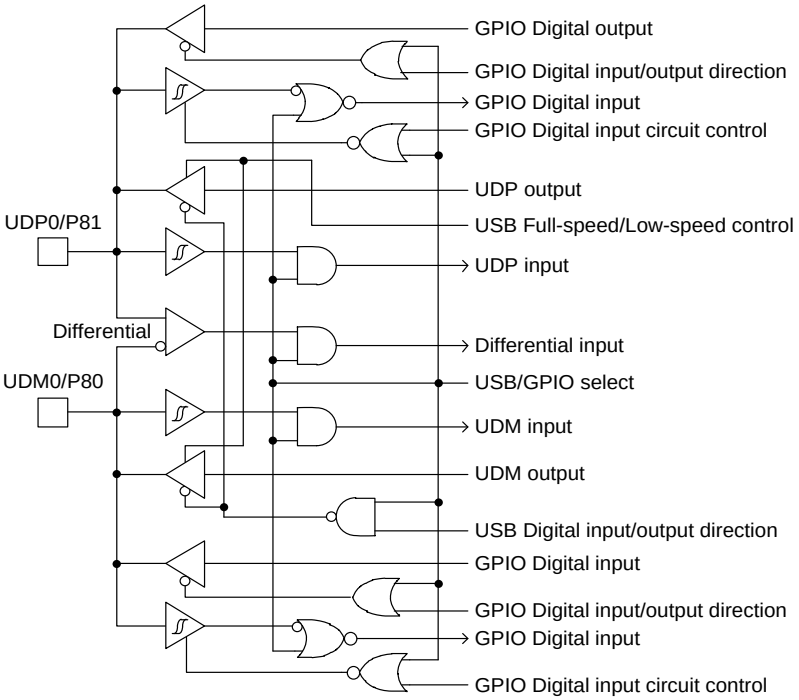
6. I/O Circuit Type

Type	Circuit	Remarks
A		It is possible to select the main oscillation / GPIO function When the main oscillation is selected. ・Oscillation feedback resistor Approximately 1 MΩ ・With standby mode control When the GPIO is selected. ・CMOS level output. ・CMOS level hysteresis input ・With pull-up resistor control ・With standby mode control ・Pull-up resistor Approximately 33 kΩ ・I_{OH}= -4 mA, I_{OL}= 4 mA
B		CMOS level hysteresis input Pull-up resistor Approximately 33 kΩ

Type	Circuit	Remarks
C		It is possible to select the sub oscillation / GPIO function When the sub oscillation is selected. ・ Oscillation feedback resistor Approximately 5 MΩ ・ With Standby mode control When the GPIO is selected. ・ CMOS level output. ・ CMOS level hysteresis input ・ With pull-up resistor control ・ With standby mode control ・ Pull-up resistor Approximately 33 kΩ I_{OH}= -4 mA, I_{OL}= 4 mA

Type	Circuit	Remarks
D		・CMOS level output ・CMOS level hysteresis input ・With pull-up resistor control ・With standby mode control ・Pull-up resistor Approximately 33 kΩ ・I_{OH}= -4mA, I_{OL}= 4 mA ・When this pin is used as an I^2C pin, the digital output P-ch transistor is always off
E		・CMOS level output ・CMOS level hysteresis input ・With pull-up resistor control ・With standby mode control ・Pull-up resistor Approximately 33 kΩ ・I_{OH}= -4 mA, I_{OL}= 4 mA ・When this pin is used as an I^2C pin, the digital output P-ch transistor is always off

Type	Circuit	Remarks
F		・CMOS level output ・CMOS level hysteresis input ・With input control ・Analog input ・With pull-up resistor control ・With standby mode control ・Pull-up resistor Approximately 33 kΩ ・I_{OH}= -4 mA, I_{OL}= 4 mA ・When this pin is used as an I^2C pin, the digital output P-ch transistor is always off
G		・CMOS level output ・CMOS level hysteresis input ・With input control ・Analog input ・With pull-up resistor control ・With standby mode control ・Pull-up resistor : Approximately 33 kΩ ・I_{OH}= -4 mA, I_{OL}= 4 mA ・When this pin is used as an I^2C pin, the digital output P-ch transistor is always off

Type	Circuit	Remarks
H		・CMOS level output ・CMOS level hysteresis input ・5V tolerant ・With pull-up resistor control ・With standby mode control ・Pull-up resistor Approximately 33 kΩ ・I_{OH}= -4 mA, I_{OL}= 4 mA ・Available to control PZR registers ・When this pin is used as an I^2C pin, the digital output P-ch transistor is always off
I		・CMOS level hysteresis input
J		It is possible to select the USB I/O / GPIO function. When the USB I/O is selected. ・Full-speed, Low-speed control When the GPIO is selected. ・CMOS level output ・CMOS level hysteresis input ・With standby mode control

7. Handling Precautions

Any semiconductor devices have inherently a certain rate of failure. The possibility of failure is greatly affected by the conditions in which they are used (circuit conditions, environmental conditions, etc.). This page describes precautions that must be observed to minimize the chance of failure and to obtain higher reliability from your Cypress semiconductor devices.

7.1 Precautions for Product Design

This section describes precautions when designing electronic equipment using semiconductor devices.

Absolute Maximum Ratings

Semiconductor devices can be permanently damaged by application of stress (voltage, current, temperature, etc.) in excess of certain established limits, called absolute maximum ratings. Do not exceed these ratings.

Recommended Operating Conditions

Recommended operating conditions are normal operating ranges for the semiconductor device. All the device's electrical characteristics are warranted when operated within these ranges.

Always use semiconductor devices within the recommended operating conditions. Operation outside these ranges may adversely affect reliability and could result in device failure.

No warranty is made with respect to uses, operating conditions, or combinations not represented on the data sheet. Users considering application outside the listed conditions are advised to contact their sales representative beforehand.

Processing and Protection of Pins

These precautions must be followed when handling the pins which connect semiconductor devices to power supply and input/output functions.

(1) Preventing Over-Voltage and Over-Current Conditions

Exposure to voltage or current levels in excess of maximum ratings at any pin is likely to cause deterioration within the device, and in extreme cases leads to permanent damage of the device. Try to prevent such overvoltage or over-current conditions at the design stage.

(2) Protection of Output Pins

Shorting of output pins to supply pins or other output pins, or connection to large capacitance can cause large current flows. Such conditions if present for extended periods of time can damage the device.

Therefore, avoid this type of connection.

(3) Handling of Unused Input Pins

Unconnected input pins with very high impedance levels can adversely affect stability of operation. Such pins should be connected through an appropriate resistance to a power supply pin or ground pin.

Latch-Up

Semiconductor devices are constructed by the formation of P-type and N-type areas on a substrate. When subjected to abnormally high voltages, internal parasitic PNPN junctions (called thyristor structures) may be formed, causing large current levels in excess of several hundred mA to flow continuously at the power supply pin. This condition is called latch-up.

CAUTION: The occurrence of latch-up not only causes loss of reliability in the semiconductor device, but can cause injury or damage from high heat, smoke or flame. To prevent this from happening, do the following:

(1) Be sure that voltages applied to pins do not exceed the absolute maximum ratings. This should include attention to abnormal noise, surge levels, etc.

(2) Be sure that abnormal current flows do not occur during the power-on sequence.

Observance of Safety Regulations and Standards

Most countries in the world have established standards and regulations regarding safety, protection from electromagnetic interference, etc. Customers are requested to observe applicable regulations and standards in the design of products.

Fail-Safe Design

Any semiconductor devices have inherently a certain rate of failure. You must protect against injury, damage or loss from such failures by incorporating safety design measures into your facility and equipment such as redundancy, fire protection, and prevention of over-current levels and other abnormal operating conditions.

Precautions Related to Usage of Devices

Cypress semiconductor devices are intended for use in standard applications (computers, office automation and other office equipment, industrial, communications, and measurement equipment, personal or household devices, etc.).

CAUTION: Customers considering the use of our products in special applications where failure or abnormal operation may directly affect human lives or cause physical injury or property damage, or where extremely high levels of reliability are demanded (such as aerospace systems, atomic energy controls, sea floor repeaters, vehicle operating controls, medical devices for life support, etc.) are requested to consult with sales representatives before such use. The company will not be responsible for damages arising from such use without prior approval.

7.2 Precautions for Package Mounting

Package mounting may be either lead insertion type or surface mount type. In either case, for heat resistance during soldering, you should mount only under Cypress' recommended conditions. For detailed information about mount conditions, contact your sales representative.

Lead Insertion Type

Mounting of lead insertion type packages onto printed circuit boards may be done by two methods: direct soldering on the board, or mounting by using a socket.

Direct mounting onto boards normally involves processes for inserting leads into through-holes on the board and using the flow soldering (wave soldering) method of applying liquid solder. In this case, the soldering process usually causes leads to be subjected to thermal stress in excess of the absolute ratings for storage temperature. Mounting processes should conform to Cypress recommended mounting conditions.

If socket mounting is used, differences in surface treatment of the socket contacts and IC lead surfaces can lead to contact deterioration after long periods. For this reason it is recommended that the surface treatment of socket contacts and IC leads be verified before mounting.

Surface Mount Type

Surface mount packaging has longer and thinner leads than lead-insertion packaging, and therefore leads are more easily deformed or bent. The use of packages with higher pin counts and narrower pin pitch results in increased susceptibility to open connections caused by deformed pins, or shorting due to solder bridges.

You must use appropriate mounting techniques. Cypress recommends the solder reflow method, and has established a ranking of mounting conditions for each product. Users are advised to mount packages in accordance with Cypress ranking of recommended conditions.

Lead-Free Packaging

CAUTION: When ball grid array (BGA) packages with Sn-Ag-Cu balls are mounted using Sn-Pb eutectic soldering, junction strength may be reduced under some conditions of use.

Storage of Semiconductor Devices

Because plastic chip packages are formed from plastic resins, exposure to natural environmental conditions will cause absorption of moisture. During mounting, the application of heat to a package that has absorbed moisture can cause surfaces to peel, reducing moisture resistance and causing packages to crack. To prevent, do the following:

(1) Avoid exposure to rapid temperature changes, which cause moisture to condense inside the product.
Store products in locations where temperature changes are slight.

(2) Use dry boxes for product storage. Products should be stored below 70% relative humidity, and at temperatures between 5 ˚C and 30 ˚C.
When you open Dry Package that recommends humidity 40% to 70% relative humidity.

(3) When necessary, Cypress packages semiconductor devices in highly moisture-resistant aluminum laminate bags, with a silica gel desiccant. Devices should be sealed in their aluminum laminate bags for storage.

(4) Avoid storing packages where they are exposed to corrosive gases or high levels of dust.

Baking

Packages that have absorbed moisture may be de-moisturized by baking (heat drying). Follow the Cypress recommended conditions for baking.

Condition: 125°C/24 h

Static Electricity

Because semiconductor devices are particularly susceptible to damage by static electricity, you must take the following precautions:

(1) Maintain relative humidity in the working environment between 40% and 70%.
Use of an apparatus for ion generation may be needed to remove electricity.

(2) Electrically ground all conveyors, solder vessels, soldering irons and peripheral equipment.

(3) Eliminate static body electricity by the use of rings or bracelets connected to ground through high resistance (on the level of 1 MΩ).
Wearing of conductive clothing and shoes, use of conductive floor mats and other measures to minimize shock loads is recommended.

(4) Ground all fixtures and instruments, or protect with anti-static measures.

(5) Avoid the use of Styrofoam or other highly static-prone materials for storage of completed board assemblies.

7.3 Precautions for Use Environment

Reliability of semiconductor devices depends on ambient temperature and other conditions as described above.

For reliable performance, do the following:

(1) Humidity

Prolonged use in high humidity can lead to leakage in devices as well as printed circuit boards. If high humidity levels are anticipated, consider anti-humidity processing.

(2) Discharge of Static Electricity

When high-voltage charges exist close to semiconductor devices, discharges can cause abnormal operation. In such cases, use anti-static measures or processing to prevent discharges.

(3) Corrosive Gases, Dust, or Oil

Exposure to corrosive gases or contact with dust or oil may lead to chemical reactions that will adversely affect the device. If you use devices in such conditions, consider ways to prevent such exposure or to protect the devices.

(4) Radiation, Including Cosmic Radiation

Most devices are not designed for environments involving exposure to radiation or cosmic radiation. Users should provide shielding as appropriate.

(5) Smoke, Flame

CAUTION: Plastic molded devices are flammable, and therefore should not be used near combustible substances. If devices begin to smoke or burn, there is danger of the release of toxic gases.

Customers considering the use of Cypress products in other special environmental conditions should consult with sales representatives.

8. Handling Devices

Power Supply Pins

In products with multiple VCC and VSS pins, respective pins at the same potential are interconnected within the device in order to prevent malfunctions such as latch-up. However, all of these pins should be connected externally to the power supply or ground lines in order to reduce electromagnetic emission levels, to prevent abnormal operation of strobe signals caused by the rise in the ground level, and to conform to the total output current rating.

Moreover, connect the current supply source with each Power supply pin and GND pin of this device at low impedance. It is also advisable that a ceramic capacitor of approximately 0.1 µF be connected as a bypass capacitor between each Power supply pin and GND pin, between AVRH pin and AVRL pin near this device.

Stabilizing Supply Voltage

A malfunction may occur when the power supply voltage fluctuates rapidly even though the fluctuation is within the recommended operating conditions of the VCC power supply voltage. As a rule, with voltage stabilization, suppress the voltage fluctuation so that the fluctuation in VCC ripple (peak-to-peak value) at the commercial frequency (50 Hz/60 Hz) does not exceed 10% of the VCC value in the recommended operating conditions, and the transient fluctuation rate does not exceed 0.1 V/µs when there is a momentary fluctuation on switching the power supply.

Crystal Oscillator Circuit

Noise near the X0/X1 and X0A/X1A pins may cause the device to malfunction. Design the printed circuit board so that X0/X1, X0A/X1A pins, the crystal oscillator, and the bypass capacitor to ground are located as close to the device as possible.

It is strongly recommended that the PC board artwork be designed such that the X0/X1 and X0A/X1A pins are surrounded by ground plane as this is expected to produce stable operation.

Evaluate oscillation of your using crystal oscillator by your mount board.

Sub Crystal Oscillator

This series sub oscillator circuit is low gain to keep the low current consumption. The crystal oscillator to fill the following conditions is recommended for sub crystal oscillator to stabilize the oscillation.

■Surface mount type

Size: More than 3.2 mm × 1.5 mm

Load capacitance: Approximately 6 pF to 7 pF

■Lead type

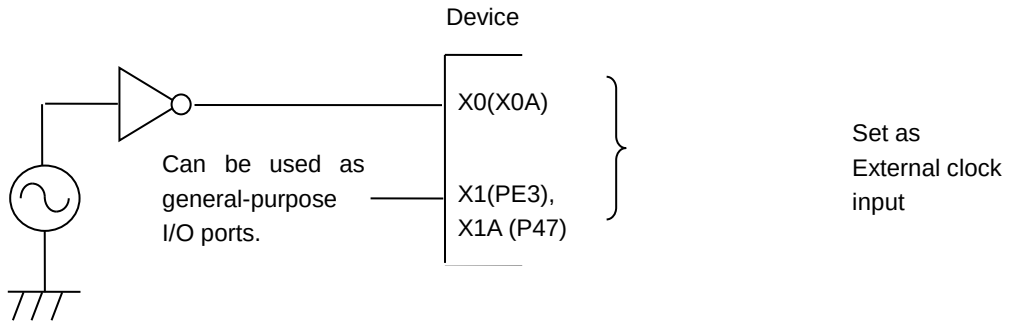
Load capacitance: Approximately 6 pF to 7 pF

Using an External Clock

When using an external clock as an input of the main clock, set X0/X1 to the external clock input, and input the clock to X0. X1(PE3) can be used as a general-purpose I/O port.
Similarly, when using an external clock as an input of the sub clock, set X0A/X1A to the external clock input, and input the clock to X0A. X1A (P47) can be used as a general-purpose I/O port.

However in the Deep Standby mode, an external clock as an input of the sub clock cannot be used.

Example of Using an External Clock



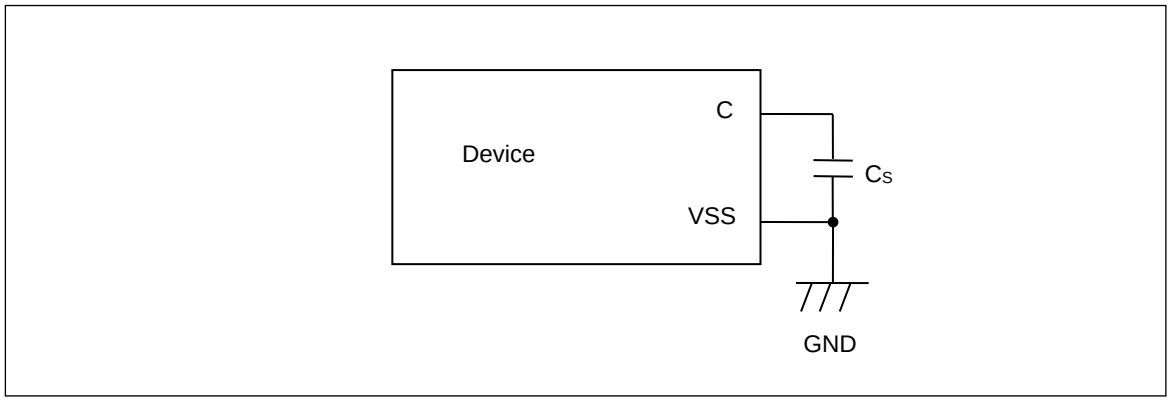
Handling when Using Multi-Function Serial Pin as I²C Pin

If it is using the multi-function serial pin as I²C pins, P-ch transistor of digital output is always disabled. However, I²C pins need to keep the electrical characteristic like other pins and not to connect to the external I²C bus system with power OFF.

C Pin

This series contains the regulator. Be sure to connect a smoothing capacitor (C_S) for the regulator between the C pin and the GND pin. Please use a ceramic capacitor or a capacitor of equivalent frequency characteristics as a smoothing capacitor.
However, some laminated ceramic capacitors have the characteristics of capacitance variation due to thermal fluctuation (F characteristics and Y5V characteristics). Please select the capacitor that meets the specifications in the operating conditions to use by evaluating the temperature characteristics of a capacitor.
A smoothing capacitor of about 4.7 µF would be recommended for this series.

Incidentally, the C pin becomes floating in Deep standby mode.



Mode Pins (MD0)

Connect the MD pin (MD0) directly to VCC or VSS pins. Design the printed circuit board such that the pull-up/down resistance stays low, as well as the distance between the mode pins and VCC pins or VSS pins is as short as possible and the connection impedance is low, when the pins are pulled-up/down such as for switching the pin level and rewriting the Flash memory data. It is because of preventing the device erroneously switching to test mode due to noise.

Notes on Power-on

Turn power on/off in the following order or at the same time.

Turning on : VCC →AVRH
Turning off : AVRH →VCC

Serial Communication

There is a possibility to receive wrong data due to the noise or other causes on the serial communication.
Therefore, design a printed circuit board so as to avoid noise.
Consider the case of receiving wrong data due to noise; perform error detection such as by applying a checksum of data at the end.
If an error is detected, retransmit the data.

Differences in Features Among the Products with Different Memory Sizes and Between Flash Memory Products and MASK Products

The electric characteristics including power consumption, ESD, latch-up, noise characteristics, and oscillation characteristics among the products with different memory sizes and between Flash memory products and MASK products are different because chip layout and memory structures are different.

If you are switching to use a different product of the same series, please make sure to evaluate the electric characteristics.

Pull-Up Function of 5 V Tolerant I/O

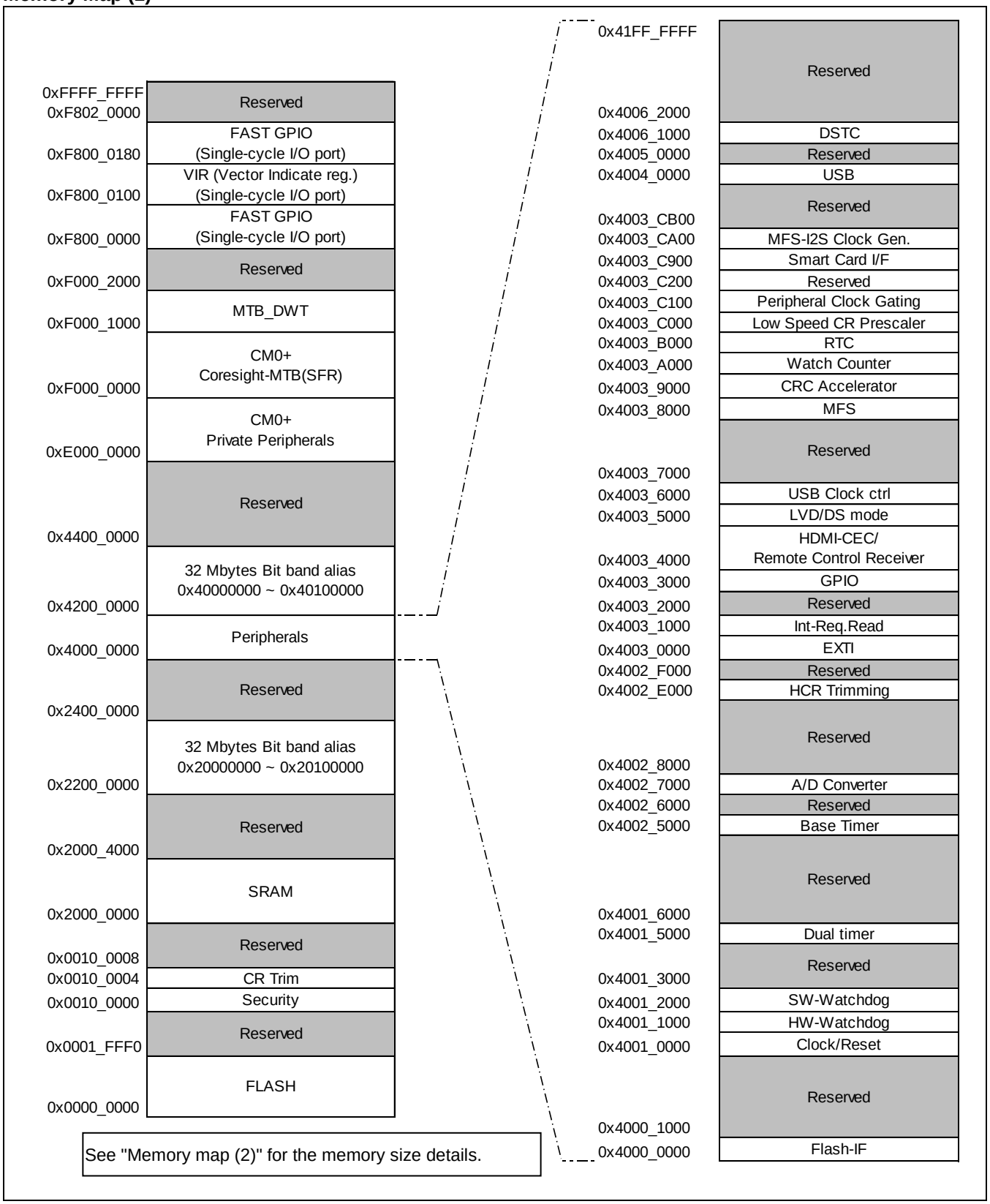
Please do not input the signal more than VCC voltage at the time of Pull-Up function use of 5 V tolerant I/O.

Handling when Using Debug Pins

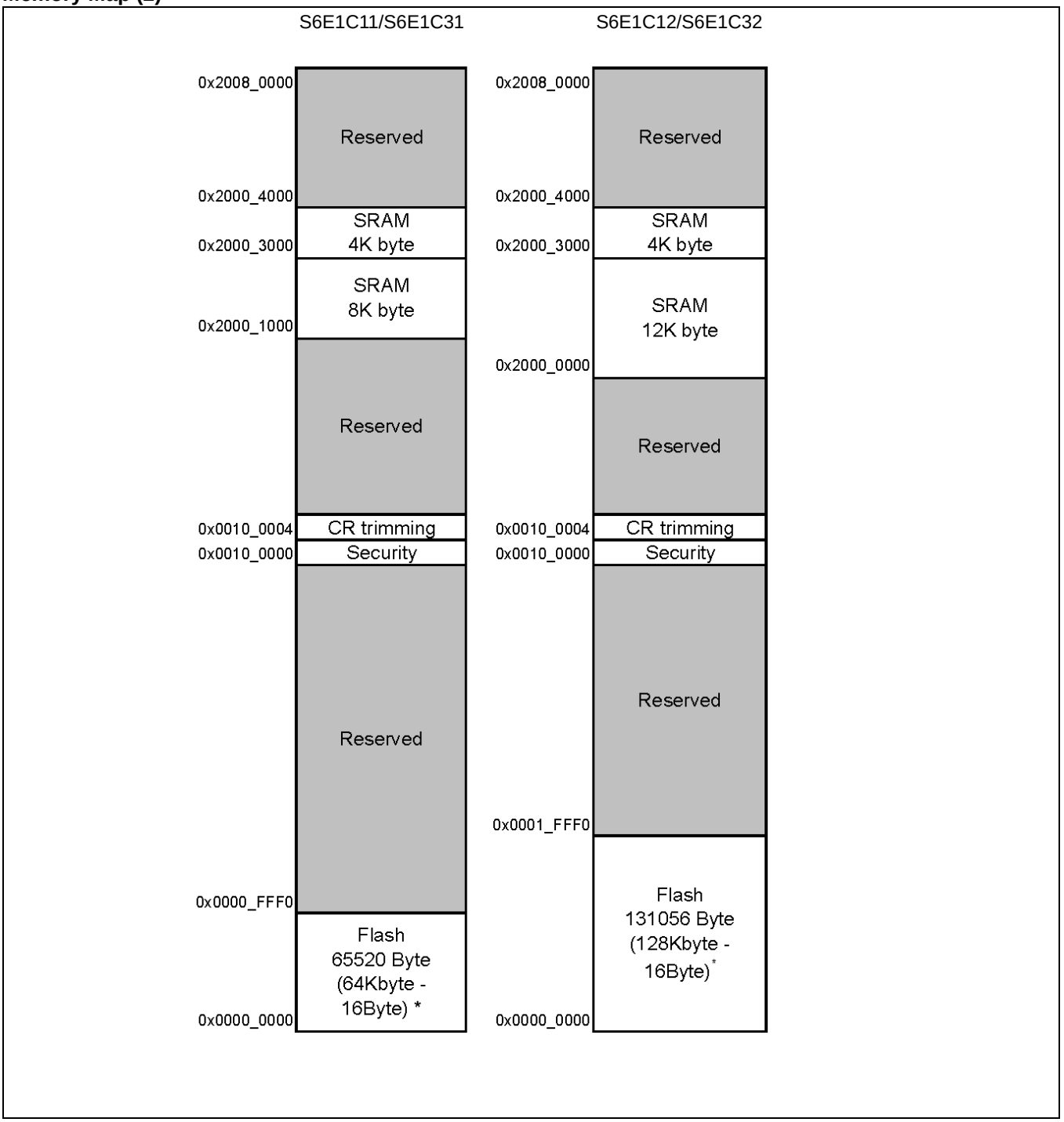
When debug pins (SWDIO/SWCLK) are set to GPIO or other peripheral functions, set them as output only; do not set them as input.

9. Memory Map

Memory Map (1)



Memory Map (2)



*: See "S6E1C1/C3 Series Flash Programming Manual" to check details of the flash memory.

Peripheral Address Map

Start Address	End Address	Bus	Peripheral
0x4000_0000	0x4000_0FFF	AHB	Flash memory I/F register
0x4000_1000	0x4000_FFFF		Reserved
0x4001_0000	0x4001_0FFF	APB0	Clock/Reset Control
0x4001_1000	0x4001_1FFF		Hardware Watchdog Timer
0x4001_2000	0x4001_2FFF		Software Watchdog Timer
0x4001_3000	0x4001_4FFF		Reserved
0x4001_5000	0x4001_5FFF		Dual-Timer
0x4001_6000	0x4001_FFFF		Reserved
0x4002_0000	0x4002_0FFF	APB1	Reserved
0x4002_1000	0x4002_3FFF		Reserved
0x4002_4000	0x4002_4FFF		Reserved
0x4002_5000	0x4002_5FFF		Base Timer
0x4002_6000	0x4002_6FFF		Reserved
0x4002_7000	0x4002_7FFF		A/D Converter
0x4002_8000	0x4002_DFFF		Reserved
0x4002_E000	0x4002_EFFF		Built-in CR trimming
0x4002_F000	0x4002_FFFF		Reserved
0x4003_0000	0x4003_0FFF		External Interrupt Controller
0x4003_1000	0x4003_1FFF		Interrupt Request Batch-Read Function
0x4003_2000	0x4003_2FFF		Reserved
0x4003_3000	0x4003_3FFF		GPIO
0x4003_4000	0x4003_4FFF		HDMI-CEC/Remote Control Receiver
0x4003_5000	0x4003_5FFF		Low-Voltage Detection / DS mode / Vref Calibration
0x4003_6000	0x4003_6FFF		USB Clock Generator
0x4003_7000	0x4003_77FF		Reserved
0x4003_7800	0x4003_79FF		Reserved
0x4003_7A00	0x4003_7FFF		Reserved
0x4003_8000	0x4003_8FFF		Multi-function Serial Interface
0x4003_9000	0x4003_9FFF		CRC
0x4003_A000	0x4003_AFFF		Watch Counter
0x4003_B000	0x4003_BFFF		Real-time clock
0x4003_C000	0x4003_C0FF		Low-speed CR Prescaler
0x4003_C100	0x4003_C7FF		Peripheral Clock Gating
0x4003_C800	0x4003_C8FF		Reserved
0x4003_C900	0x4003_C9FF		Smart Card Interface
0x4003_CA00	0x4003_CAFF		MFS-I2S Clock Generator
0x4003_CB00	0x4003_FFFF		Reserved
0x4004_0000	0x4004_FFFF	AHB	USB ch.0
0x4005_0000	0x4006_0FFF		Reserved
0x4006_1000	0x4006_1FFF		DSTC
0x4006_2000	0x41FF_FFFF		Reserved

10. Pin Status in Each CPU State

The following table shows pin status in each CPU state.

Type	Selected Pin Function		CPU State							
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A	Main oscillation circuit selected[3]	Main oscillation circuit selected	OS	OS	OE	OE	OE	GS	IS	OS
	Digital I/O selected[4]	Main clock external input selected	-	-	IE/IS	IE/IS	IE/IS	IS	IS	IS
		GPIO selected	-	-	PC	HC	IS	HS	IS	HS
B	Main oscillation circuit selected[3]	Main oscillation circuit selected	OS	OS	OE	OE	OE	GS	IS	OS
	Digital I/O selected[4]	GPIO selected	-	-	PC	HC	IS	GS	IS	GS
C	Sub oscillation circuit selected[3]	Sub oscillation circuit selected	OS	OE	OE	OE	OE	OE	OE	OE
	Digital I/O selected[4]	Sub clock external input selected	-	-	IE/IS	IE/IS	IE/IS	IS	IS	IS
		GPIO selected	-	-	PC	HC	IS	HS	IS	HS
D	Sub oscillation circuit selected [3]	Sub oscillation circuit selected	OS	OE	OE	OE	OE	OE	OE	OE
	Digital I/O selected[4]	GPIO selected	-	-	PC	HC	IS	HS	IS	HS
E	Digital I/O selected	INITX input	This pin is digital input pin, pull up resistor is on, and digital input is not shut off in all CPU states.							
F	Digital I/O selected	MD0 input	This pin is digital input pin, pull up resistor is none, digital input is not shut off in all CPU states.							
G	USB I/O selected[5]	USB port selected	-	-	UE	US	US	US	US	US
	Digital I/O selected[6]	GPIO selected	IS	IE	CP	HC	IS	HS	IS	HS
H	Digital I/O selected	SW selected	IS	IP[7]	PC	IP	IP	IP	IP	IP
		GPIO selected	-	-	PC	HC	IS	HS	IS	HS
I	Digital I/O selected	NMI selected	-	-	IP	IP	IP	-	-	-
		WKUP0 enable and input selected	-	-	IP	IP	IP	IP	IP	IP
		GPIO selected	IS	IE	PC	HC	IS	-	-	-
J	Analog input selected[8]	Analog input selected	Analog input is enabled in all CPU state							
	Digital I/O selected[9]	WKUP enable and input selected	-	-	IP	IP	IP	IP	IP	IP
		External interrupt enable and input selected	-	-	IP	IP	IP	GS	IS	GS
		GPIO selected	-	-	PC	HC	IS	HS	IS	HS
		Resource other than above selected	-	-	PC	HC	IS	GS	IS	GS
K	Digital I/O selected	CEC pin selected	-	-	CP	CP	CP	CP	CP	CP
		WKUP enable and input selected	-	-	IP	IP	IP	IP	IP	IP
		External interrupt enable and input selected	-	-	PC	HC	IP	GS	IS	GS
		GPIO selected	IS	IE	PC	HC	IS	HS	IS	HS
		Resource other than above selected	-	-	PC	HC	IS	GS	IS	GS

Terms in the table above have the following meanings.

[3] In this type, when internal oscillation function is selected, digital output is disabled. (Hi-Z) pull up resistor is off, digital input is shut off by fixed 0.
[4] In this type, when Digital I/O function is selected, internal oscillation function is disabled.
[5] In this type, when USB I/O function is selected, digital output is disabled. (Hi-Z), digital input is shut off by fixed 0.
[6] In this type, when Digital I/O function is selected, USB I/O function is disabled.This pin does not have pull up resistor.
[7] In this case, PCR register is initialized to “1”. Pull up resistor is on.
[8] In this type, when analog input function is selected, digital output is disabled, (Hi-Z). pull up resistor is off, digital input is shut off by fixed 0.
[9] In this type, when Digital I/O function is selected, analog input function is not available.

Type
This indicates a pin status type that is shown in “pin list table” in “5. List of Pin Functions”

Selected Pin function
This indicates a pin function that is selected by user program.

CPU state
This indicates a state of the CPU that is shown below.

(1) Reset state. CPU is initialized by Power-on reset or a reset due to low Power voltage supply.

(2) Reset state. CPU is initialized by INITX input signal or system initialization after power on reset.

(3) Run mode or SLEEP mode state.

(4) Timer mode, RTC mode or STOP mode state.
The standby pin level setting bit (SPL) in the Standby Mode Control Register (STB_CTL) is set to "0".

(5) Timer mode, RTC mode or STOP mode state.
The standby pin level setting bit (SPL) in the Standby Mode Control Register (STB_CTL) is set to "1".

(6) Deep standby STOP mode or Deep standby RTC mode state,
The standby pin level setting bit (SPL) in the Standby Mode Control Register (STB_CTL) is set to "0"

(7) Deep standby STOP mode or Deep standby RTC mode state,
The standby pin level setting bit (SPL) in the Standby Mode Control Register (STB_CTL) is set to "1"

(8) Run mode state after returning from Deep Standby mode.
(I/O state hold function(CONTX) is fixed at 1)

Each pin status

The meaning of the symbols in the pin status table is as follows.

IS	Digital output is disabled. (Hi-Z) Pull up resistor is off. Digital input is shut off by fixed 0.
IE	Digital output is disabled. (Hi-Z) Pull up resistor is off. Digital input is not shut off.
IP	Digital output is disabled. (Hi-Z) Pull up resistor is defined by the value of the PCR register. Digital input is not shut off.
IE/IS	Digital output is disabled. (Hi-Z) Pull up resistor is off. Digital input is shut off in case of the OSC stop. Digital input is not shut off in case of the OSC operation.
OE	The OSC is in operation state. However, it may be stopped in some operation mode of the CPU. For detail, see chapter “Low Power Consumption Mode” in peripheral manual.
OS	The OSC is in stop state. (Hi-Z)
UE	USB I/O function is controlled by USB controller.
US	USB I/O function is disabled(Hi-Z)
PC	Digital output and pull up resistor is controlled by the register in the GPIO or peripheral function. Digital input is not shut off
CP	Digital output is controlled by the register in the GPIO or peripheral function. Pull up resistor is off. Digital input is not shut off.
HC	Digital output and pull up resistor is maintained the status that is immediately prior to entering the current CPU state. Digital input is not shut off
HS	Digital output and pull up resistor is maintained the status that is immediately prior to entering the current CPU state. Digital input is shut off
GS	Digital output and pull up resistor is copied the GPIO status that is immediately prior to entering the current CPU state and the status is maintained. Digital input is shut off.

11. Electrical Characteristics

11.1 Absolute Maximum Ratings

Parameter	Symbol	Rating		Unit	Remarks
		Min	Max		
Power supply voltage[10, 11]	V_{CC}	V_{SS} - 0.5	V_{SS} + 4.6	V	
Analog reference voltage[10, 12]	AVRH	V_{SS} - 0.5	V_{SS} + 4.6	V	
Input voltage[10]	V_I	V_{SS} - 0.5	V_{CC} + 0.5 (≤ 4.6 V)	V	
		V_{SS} - 0.5	V_{SS} + 6.5	V	5 V tolerant
Analog pin input voltage[10]	V_{IA}	V_{SS} - 0.5	V_{CC} + 0.5 (≤ 4.6 V)	V	
Output voltage[10]	V_O	V_{SS} - 0.5	Vcc + 0.5 (≤ 4.6 V)	V	
L level maximum output current[13]	I_{OL}	-	10	mA	4 mA type
L level average output current[14]	I_{OLAV}	-	4	mA	4 mA type
L level total maximum output current	$\sum I_{OL}$	-	100	mA	
L level total average output current[15]	$\sum I_{OLAV}$	-	50	mA	
H level maximum output current[13]	I_{OH}	-	- 10	mA	4 mA type
H level average output current[14]	I_{OHAV}	-	- 4	mA	4 mA type
H level total maximum output current	$\sum I_{OH}$	-	- 100	mA	
H level total average output current[15]	$\sum I_{OHAV}$	-	- 50	mA	
Power consumption	P_D	-	200	mW	
Storage temperature	T_{STG}	- 55	+ 150	°C	

<WARNING>

- *Semiconductor devices can be permanently damaged by application of stress (voltage, current, temperature, etc.) in excess of absolute maximum ratings. Do not exceed these ratings.*

[10] These parameters are based on the condition that V_{SS}= 0 V.
[11] V_{CC} must not drop below V_{SS} - 0.5 V.
[12] Ensure that the voltage does not to exceed V_{CC} + 0.5 V at power-on.
[13] The maximum output current is the peak value for a single pin.
[14] The average output is the average current for a single pin over a period of 100 ms.
[15] The total average output current is the average current for all pins over a period of 100 ms.

11.2 Recommended Operating Conditions

(V_{SS}= 0.0 V)

Parameter	Symbol	Conditions	Value		Unit	Remarks
			Min	Max		
Power supply voltage	V_{CC}	-	1.65[16]	3.6	V	
			3.0	3.6	V	[17]
Analog reference voltage	AVRH	-	2.7	V_{CC}	V	$V_{CC} \geq 2.7$ V
			V_{CC}	V_{CC}	V	$V_{CC} < 2.7$ V
	AVRL	-	V_{SS}	V_{SS}	V	
Smoothing capacitor	C_S	-	1	10	µF	For regulator[18]
Operating temperature	Ta	-	- 40	+ 105	°C	

<WARNING>

1. *The recommended operating conditions are required in order to ensure the normal operation of the semiconductor device. All of the device's electrical characteristics are warranted when the device is operated within these ranges.*
2. *Always use semiconductor devices within their recommended operating condition ranges. Operation outside these ranges may adversely affect reliability and could result in device failure.*
3. *No warranty is made with respect to uses, operating conditions, or combinations not represented on the data sheet.*
4. *Users considering application outside the listed conditions are advised to contact their representatives beforehand.*

[16] In between less than the minimum power supply voltage reset / interrupt detection voltage or more, instruction execution and low voltage detection function by built-in High-speed CR (including Main PLL is used) or built-in Low-speed CR is possible to operate only.
[17] When P81/UDP0 and P80/UDM0 pins are used as USB (UDP0, UDM0).
[18] See "C Pin" in "8. Handling Devices" for the connection of the smoothing capacitor.

11.3 DC Characteristics

11.3.1 Current Rating

Symbol (Pin Name)	Conditions		HCLK Frequency[19]	Value Typ[20]	Value Max[21]	Unit	Remarks
Icc (VCC)	Run mode, code executed from Flash	8 MHz external clock input, PLL ON[22] NOP code executed Built-in high speed CR stopped All peripheral clock stopped by CKENx	8 MHz	1.4	2.7	mA	[23]
			20 MHz	2.6	4.1		
			40 MHz	3.9	5.6		
		8 MHz external clock input, PLL ON[22] Benchmark code executed Built-in high speed CR stopped PCLK1 stopped	8 MHz	1.3	2.6	mA	[23]
			20 MHz	2.3	3.8		
			40 MHz	3.4	5.1		
		8 MHz crystal oscillation, PLL ON[22] NOP code executed Built-in high speed CR stopped All peripheral clock stopped by CKENx	8 MHz	1.6	3.0	mA	[23], [24],
			20 MHz	2.8	4.4		
			40 MHz	4.1	5.9		
	Run mode, code executed from RAM	8 MHz external clock input, PLL ON[22] NOP code executed Built-in high speed CR stopped All peripheral clock stopped by CKENx	8 MHz	1.0	2.1	mA	[23]
			20 MHz	1.7	2.9		
			40 MHz	2.7	4.0		
	Run mode, code executed from Flash	8 MHz external clock input, PLL ON NOP code executed Built-in high speed CR stopped PCLK1 stopped	40 MHz	1.6	3.1	mA	[23], [25], [26]
	Run mode, code executed from Flash	Built-in high speed CR[27] NOP code executed All peripheral clock stopped by CKENx	8 MHz	1.1	2.4	mA	[23]
		32 kHz crystal oscillation NOP code executed All peripheral clock stopped by CKENx	32 kHz	240	1264	µA	[23]
		Built-in low speed CR NOP code executed All peripheral clock stopped by CKENx	100 kHz	246	1271	µA	[23]
Iccs (VCC)	Sleep operation	8 MHz external clock input, PLL ON[22] All peripheral clock stopped by CKENx	8 MHz	0.8	1.9	mA	[23]
			20 MHz	1.3	2.4		
			40 MHz	1.8	3.0		
		Built-in high speed CR[27] All peripheral clock stopped by CKENx	8 MHz	0.6	1.7	mA	[23]
		32 kHz crystal oscillation All peripheral clock stopped by CKENx	32 kHz	237	1261	µA	[23]
		Built-in low speed CR All peripheral clock stopped by CKENx	100 kHz	238	1262	µA	[23]

[19] PCLK0 is set to divided rate 8.
[20] T_A=+25°C,V_{CC}=3.3 V
[21] T_A=+105°C,V_{CC}=3.6 V
[22] When HCLK=8, PLL is off.
[23] All ports are fixed
[24] When IMAINSEL bit (MOSC_CTL:IMAINSEL) is “10” (default).
[25] Flash sync down is set to FRWTR.RWT=111 and FSYNDN.SD=1111
[26] VCC=1.65 V
[27] The frequency is set to 8 MHz by trimming

Parameter	Symbol (Pin Name)	Conditions		Value		Unit	Remarks
				Typ	Max		
Power supply current	I_{CCH} (VCC)	Stop mode	Ta=25℃ Vcc=3.3 V	12.4	52.4	µA	[28], [29]
			Ta=25℃ Vcc=1.65 V	12.0	52.0	µA	[28], [29]
			Ta=105℃ Vcc=3.6 V	-	597	µA	[28], [29]
	I_{CCT} (VCC)	Sub timer mode	Ta=25℃ Vcc=3.3 V 32 kHz Crystal oscillation	15.6	55.6	µA	[28], [29]
			Ta=25℃ Vcc=1.65 V 32 kHz Crystal oscillation	15.0	55.0	µA	[28], [29]
			Ta=105℃ Vcc=3.6 V 32 kHz Crystal oscillation	-	601	µA	[28], [29]
	I_{CCR} (VCC)	RTC mode	Ta=25℃ Vcc=3.3 V 32 kHz Crystal oscillation	13.2	53.2	µA	[28], [29]
			Ta=25℃ Vcc=1.65 V 32 kHz Crystal oscillation	12.7	52.7	µA	[28], [29]
			Ta=105℃ Vcc=3.6 V 32 kHz Crystal oscillation	-	598	µA	[28], [29]

[28] All ports are fixed. LVD off. Flash off.
[29] When CALDONE bit(CAL_CTL:CALDONE) is “1”. In case of “0”, Bipolar Vref current is added.

Parameter	Symbol (Pin Name)	Conditions			Value		Unit	Remarks
					Typ	Max		
Power supply current	I_{CCHD} (VCC)	Deep standby Stop mode	RAM off	Ta=25°C Vcc=3.3 V	0.58	1.85	µA	[30], [31]
				Ta=25°C Vcc=1.65 V	0.56	1.83	µA	[30], [31]
				Ta=105°C Vcc=3.6 V	-	46	µA	[30], [31]
			RAM on	Ta=25°C Vcc=3.3 V	0.78	6.6	µA	[30], [31]
				Ta=25°C Vcc=1.65 V	0.76	6.6	µA	[30], [31]
				Ta=105°C Vcc=3.6 V	-	88	µA	[30], [31]
	I_{CCRD} (VCC)	Deep standby RTC mode	RAM off	Ta=25°C Vcc=3.3 V	1.16	2.4	µA	[30], [31]
				Ta=25°C Vcc=1.65 V	1.15	2.4	µA	[30], [31]
				Ta=105°C Vcc=3.6 V	-	46	µA	[30], [31]
			RAM on	Ta=25°C Vcc=3.3 V	1.37	7.2	µA	[30], [31]
				Ta=25°C Vcc=1.65 V	1.35	7.2	µA	[30], [31]
				Ta=105°C Vcc=3.6 V	-	88	µA	[30], [31]

[30] All ports are fixed. LVD off.
[31] When CALDONE bit(CAL_CTL:CALDONE) is “1”. In case of “0”, Bipolar Vref current is added.

LVD Current

(V_{CC}=1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Conditions	Value		Unit	Remarks
				Typ	Max		
Low-Voltage detection circuit (LVD) power supply current	I_{CCLVD}	VCC	At operation	0.15	0.3	µA	For occurrence of reset
				0.10	0.3	µA	For occurrence of interrupt

Bipolar Vref Current

(V_{CC}=1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Conditions	Value		Unit	Remarks
				Typ	Max		
Bipolar Vref Current	I_{CCBGR}	VCC	At operation	100	200	µA	

Flash Memory Current

(V_{CC}=1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Conditions	Value		Unit	Remarks
				Typ	Max		
Flash memory write/erase current	$I_{CCFLASH}$	VCC	At Write/Erase	4.4	5.6	mA	

A/D converter Current

(V_{CC}=1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Conditions	Value		Unit	Remarks
				Typ	Max		
Power supply current	I_{CCAD}	VCC	At operation	0.5	0.75	mA	
Reference power supply current (AVRH)	I_{CCAVRH}	AVRH	At operation	0.69	1.3	mA	AVRH=3.6 V
			At stop	0.1	1.3	µA	

Peripheral Current Dissipation

(V_{CC}=1.65 V to 3.6 V, V_{SS}=0 V, T_A=- 40°C to +105°C)

Clock System	Peripheral	Conditions	Frequency (MHz)			Unit	Remarks
			8	20	40		
HCLK	GPIO	At all ports operation	0.05	0.12	0.23	mA	
	DSTC	At 2ch operation	0.02	0.06	0.10		
	USB	At 1ch operation	0.13	0.13	0.13	mA	[32]
PCLK1	Base timer	At 4ch operation	0.02	0.05	0.10	mA	
	ADC	At 1 unit operation	0.04	0.10	0.21		
	Multi-function serial	At 1ch operation	0.01	0.03	0.06		
	MFS-I2S	At 1ch operation	0.02	0.05	0.08		
	Smart Card I/F	At 1ch operation	0.04	0.08	0.18		

[32] USB itself uses 48 MHz clock

11.3.2 Pin Characteristics

(V_{CC} = 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

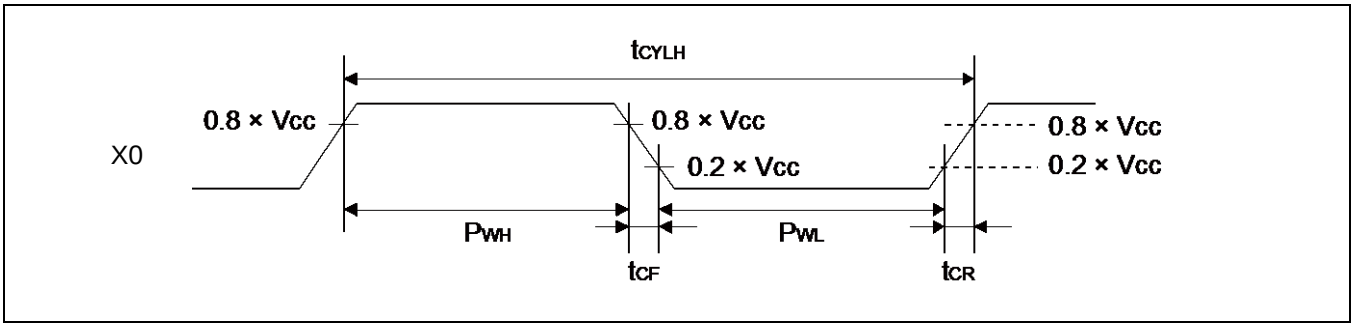
Parameter	Symbol	Pin Name	Conditions	Value			Unit	Remarks
				Min	Typ	Max		
H level input voltage (hysteresis input)	V_{IHS}	CMOS hysteresis input pin, MD0	$V_{CC} \geq 2.7$ V	$V_{CC} \times 0.8$	-	V_{CC} +0.3	V	
			$V_{CC} < 2.7$ V	$V_{CC} \times 0.7$				
		5 V tolerant input pin	$V_{CC} \geq 2.7$ V	$V_{CC} \times 0.8$	-	V_{SS} +5.5	V	
			$V_{CC} < 2.7$ V	$V_{CC} \times 0.7$				
L level input voltage (hysteresis input)	V_{ILS}	CMOS hysteresis input pin, MD0	$V_{CC} \geq 2.7$ V	V_{SS} - 0.3	-	$V_{CC} \times 0.2$	V	
			$V_{CC} < 2.7$ V			$V_{CC} \times 0.3$		
		5 V tolerant input pin	$V_{CC} \geq 2.7$ V	V_{SS} - 0.3	-	$V_{CC} \times 0.2$	V	
			$V_{CC} < 2.7$ V		-	$V_{CC} \times 0.3$		
H level output voltage	V_{OH}	4 mA type	$V_{CC} \geq 2.7$ V, I_{OH} = - 4 mA	V_{CC} - 0.5	-	V_{CC}	V	
			$V_{CC} < 2.7$ V, I_{OH} = - 2 mA	V_{CC} - 0.45				
L level output voltage	V_{OL}	4 mA type	$V_{CC} \geq 2.7$ V, I_{OL} 4 mA	V_{SS}	-	0.4	V	
			$V_{CC} < 2.7$ V, I_{OL}=2 mA					
Input leak current	I_{IL}	-	-	- 5	-	+ 5	µA	
Pull-up resistance value	R_{PU}	Pull-up pin	$V_{CC} \geq 2.7$ V	21	33	48	kΩ	
			$V_{CC} < 2.7$ V	-	-	88		
Input capacitance	C_{IN}	Other than VCC, VSS, AVRH	-	-	5	15	pF	

11.4 AC Characteristics

11.4.1 Main Clock Input Characteristics

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin name	Conditions	Value		Unit	Remarks
				Min	Max		
Input frequency	F_{CH}	X0, X1	V_{CC} ≥ 2.7V	8	48	MHz	When the crystal oscillator is connected
			V_{CC} < 2.7V	8	20		
			-	8	48	MHz	When the external clock is used
Input clock cycle	t_{CYLH}		-	20.83	125	ns	When the external clock is used
Input clock pulse width	-		P_{WH}/t_{CYLH}, P_{WL}/t_{CYLH}	45	55	%	When the external clock is used
Input clock rising time and falling time	t_{CF}, t_{CR}		-	-	5	ns	When the external clock is used
Internal operating clock[33] frequency	F_{CM}	-	-	-	40.8	MHz	Master clock
	F_{CC}	-	-	-	40.8	MHz	Base clock (HCLK/FCLK)
	F_{CP0}	-	-	-	40.8	MHz	APB0 bus clock[34]
	F_{CP1}	-	-	-	40.8	MHz	APB1 bus clock[34]
Internal operating clock[33] cycle time	t_{CYCCM}	-	-	24.5	-	ns	Master clock
	t_{CYCC}	-	-	24.5	-	ns	Base clock (HCLK/FCLK)
	t_{CYCP0}	-	-	24.5	-	ns	APB0 bus clock[34]
	t_{CYCP1}	-	-	24.5	-	ns	APB1 bus clock[34]

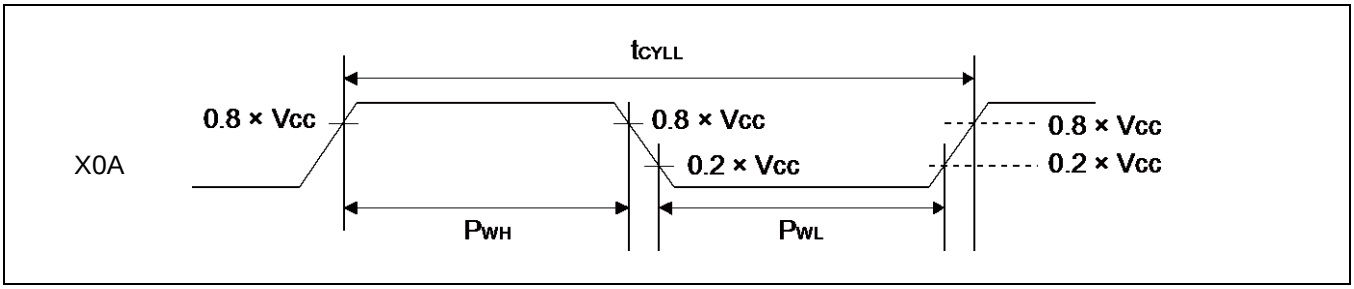


[33] For details of each internal operating clock, refer to "Chapter: Clock" in "FM0+ Family Peripheral Manual".
[34] For details of the APB bus to which a peripheral is connected, see the Peripheral Address Map.

11.4.2 Sub Clock Input Characteristics[35]

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Conditions	Value			Unit	Remarks
				Min	Typ	Max		
Input frequency	f_{CL}	X0A, X1A	-	-	32.768	-	kHz	When the crystal oscillator is connected
			-	32	-	100	kHz	When the external clock is used
Input clock cycle	t_{CYLL}		-	10	-	31.25	µs	When the external clock is used
Input clock pulse width	-		P_{WH}/t_{CYLL}, P_{WL}/t_{CYLL}	45	-	55	%	When the external clock is used



[35] See "Sub crystal oscillator" in "11. Handling Devices" for the crystal oscillator used.

11.4.3 Built-in CR Oscillation Characteristics

Built-in High-Speed CR

(V_{CC}= 1.65 V to 3.6 V, V_{SS} = 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Conditions	Value			Unit	Remarks
			Min	Typ	Max		
Clock frequency	F_{CRH}	Ta = - 10°C to + 105°C,	7.92	8	8.08	MHz	After trimming[36]
		Ta = - 40°C to + 105°C,	7.84	8	8.16	MHz	
Frequency stabilization time	t_{CRWT}	-	-	-	300	µs	[37]

Built-in Low-Speed CR

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Conditions	Value			Unit	Remarks
			Min	Typ	Max		
Clock frequency	f_{CRL}	-	50	100	150	kHz	

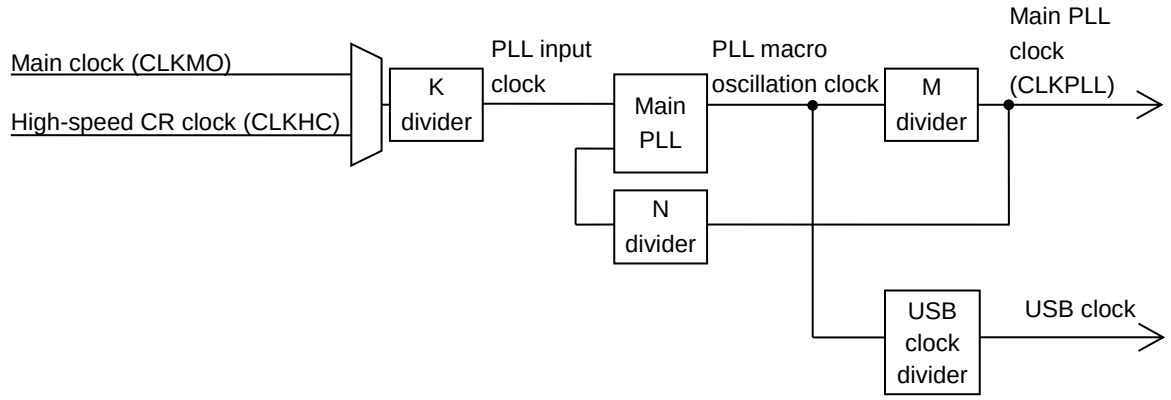
[36] In the case of using the values in CR trimming area of Flash memory at shipment for frequency trimming/temperature trimming.
[37] This is time from the trim value setting to stable of the frequency of the High-speed CR clock.
After setting the trim value, the period when the frequency stability time passes can use the High-speed CR clock as a source clock.

11.4.4 Operating Conditions of Main PLL (In the Case of Using the Main Clock as the Input Clock of the PLL)

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Value			Unit	Remarks
		Min	Typ	Max		
PLL oscillation stabilization wait time[38] (LOCK UP time)	t_{LOCK}	50	-	-	µs	
PLL input clock frequency	F_{PLLI}	8	-	16	MHz	
PLL multiple rate	-	5	-	18	multiple	
PLL macro oscillation clock frequency	F_{PLLO}	75	-	150	MHz	
Main PLL clock frequency[39]	F_{CLKPLL}	-	-	40	MHz	
USB clock frequency[40]	$F_{CLKSPLL}$	-	-	48	MHz	

Main PLL connection



11.4.5 Operating Conditions of Main PLL (In the Case of Using the Built-in High-Speed CR Clock as the Input Clock of the Main PLL)

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Value			Unit	Remarks
		Min	Typ	Max		
PLL oscillation stabilization wait time[41] (LOCK UP time)	t_{LOCK}	50	-	-	µs	
PLL input clock frequency	F_{PLLI}	7.84	8	8.16	MHz	
PLL multiple rate	-	9	-	18	multiple	
PLL macro oscillation clock frequency	F_{PLLO}	75	-	150	MHz	
Main PLL clock frequency[42]	F_{CLKPLL}	-	-	40.8	MHz	

Note:

- *For the main PLL source clock, input the high-speed CR clock (CLKHC) whose frequency and temperature have been trimmed. When setting PLL multiple rate, please take the accuracy of the built-in High-speed CR clock into account and prevent the master clock from exceeding the maximum frequency.*

[38] The wait time is the time it takes for PLL oscillation to stabilize.
[39] For details of the main PLL clock (CLKPLL), refer to "Chapter: Clock" in "FM0+ Family Peripheral Manual".
[40] For more information about USB clock, see "Chapter: USB Clock Generation" in "FM0+ Family Peripheral Manual Communication Macro Part".
[41] The wait time is the time it takes for PLL oscillation to stabilize.
[42] For details of the main PLL clock (CLKPLL), refer to "Chapter: Clock" in "FM0+ Family Peripheral Manual".

11.4.6 Reset Input Characteristics

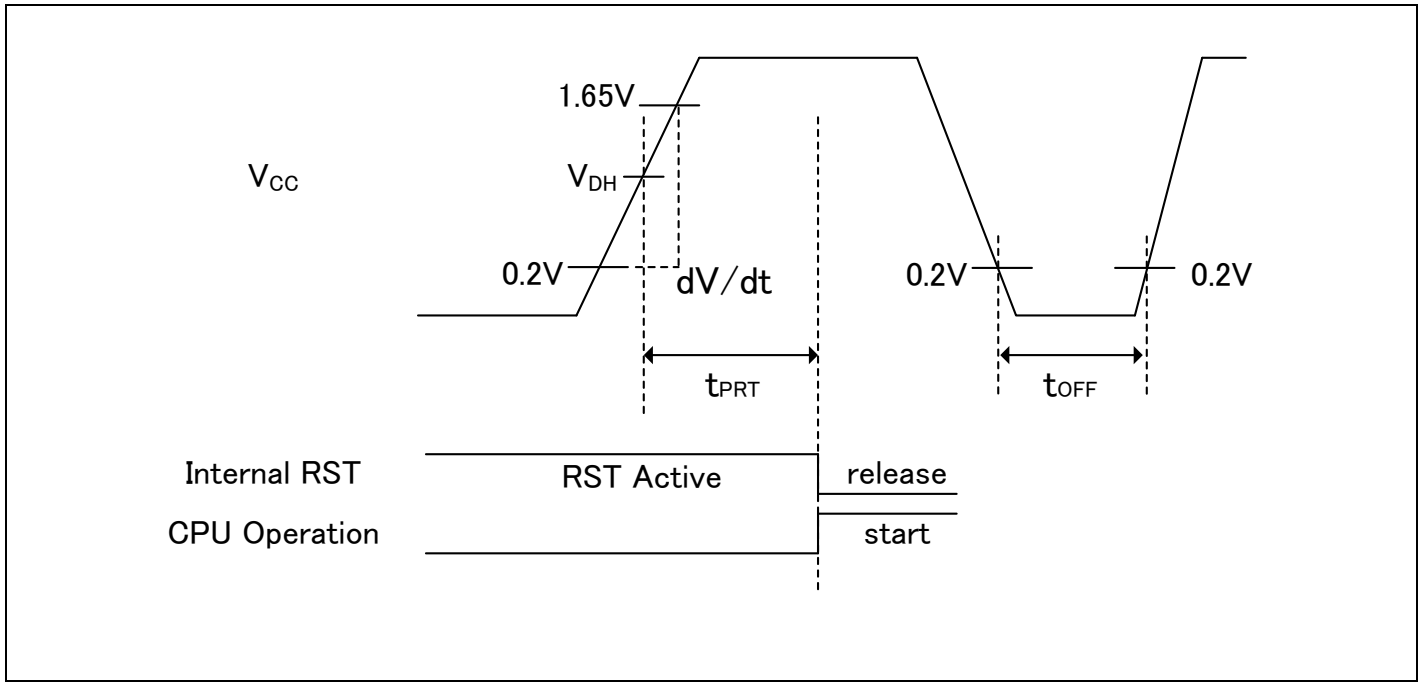
(V_{CC} = 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Conditions	Value		Unit	Remarks
				Min	Max		
Reset input time	t_{INITX}	INITX	-	500	-	ns	

11.4.7 Power-on Reset Timing

(V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Condition	Value			Unit	Remarks
				Min	Typ	Max		
Power supply shut down time	t_{OFF}	VCC	-	2	-	-	ms	V_{CC} must be held below 0.2V for a minimum period of t_{OFF}. Improper initialization may occur if this condition is not met.
Power ramp rate	dV/dt		Vcc: 0.2V to 1.65V	0.6	-	1000	mV/µs	This dV/dt characteristic is applied at the power-on of cold start (t_{OFF}>2ms).
Time until releasing Power-on reset	t_{PRT}		-	0.43	-	3.4	ms	



Glossary

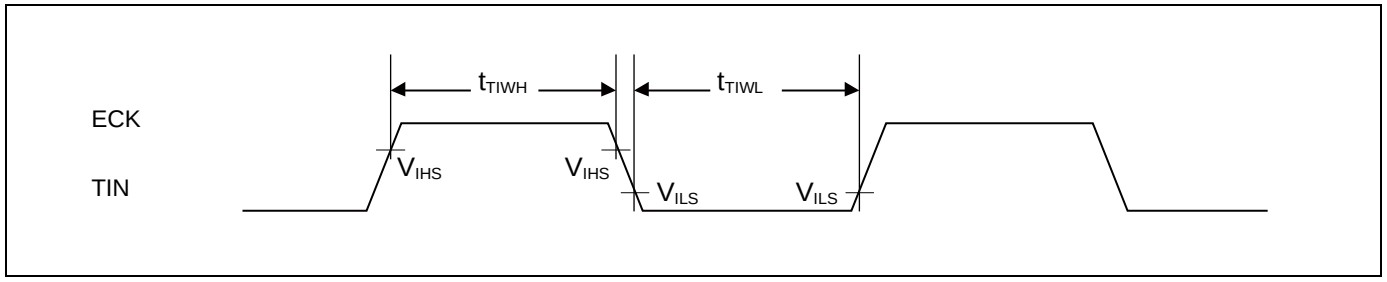
- VDH: detection voltage of Low-Voltage detection reset. See "11.7 Low-Voltage Detection Characteristics".

11.4.8 Base Timer Input Timing

Timer Input Timing

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

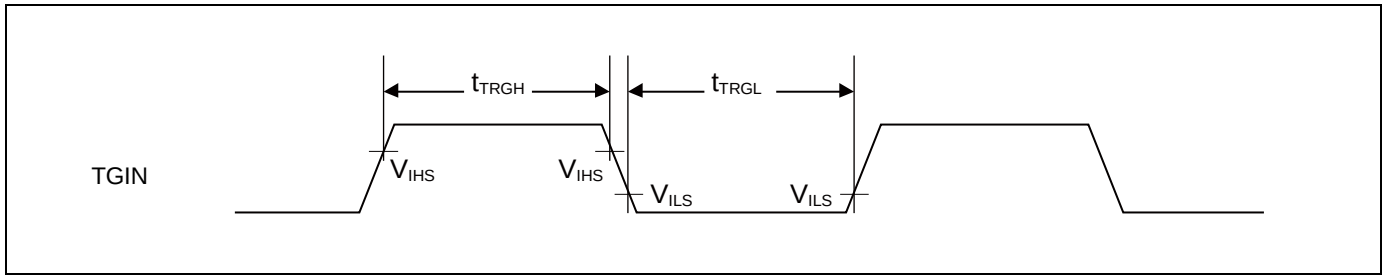
Parameter	Symbol	Pin Name	Conditions	Value		Unit	Remarks
				Min	Max		
Input pulse width	t_{TIWH}, t_{TIWL}	TIOAn/TIOBn (when using as ECK, TIN)	-	2 t_{CYCP}	-	ns	



Trigger Input Timing

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Conditions	Value		Unit	Remarks
				Min	Max		
Input pulse width	t_{TRGH}, t_{TRGL}	TIOAn/TIOBn (when using as TGIN)	-	2 t_{CYCP}	-	ns	



Note:

- *t_{CYCP} indicates the APB bus clock cycle time.*
  For the number of the APB bus to which the Base Timer has been connected, see the Peripheral Address Map
- *".*

11.4.9 CSIO/SPI/UART Timing

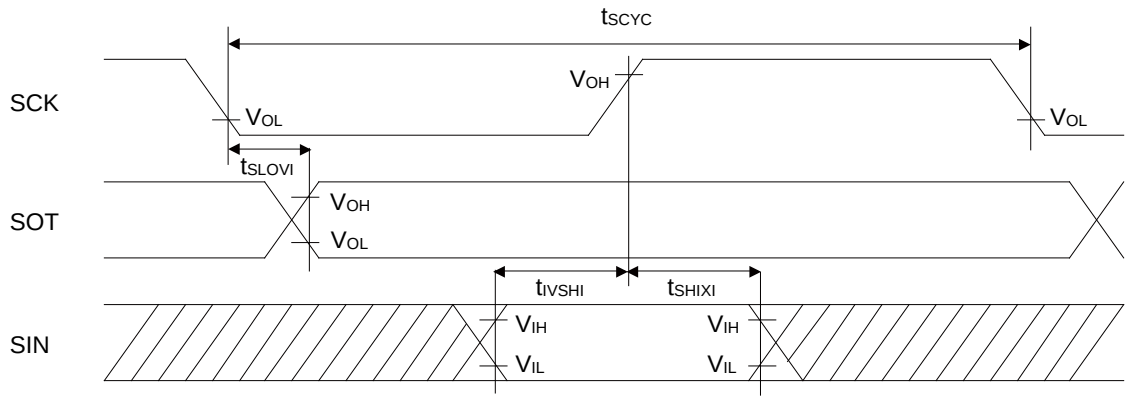
CSIO (SPI=0, SCINV=0)

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

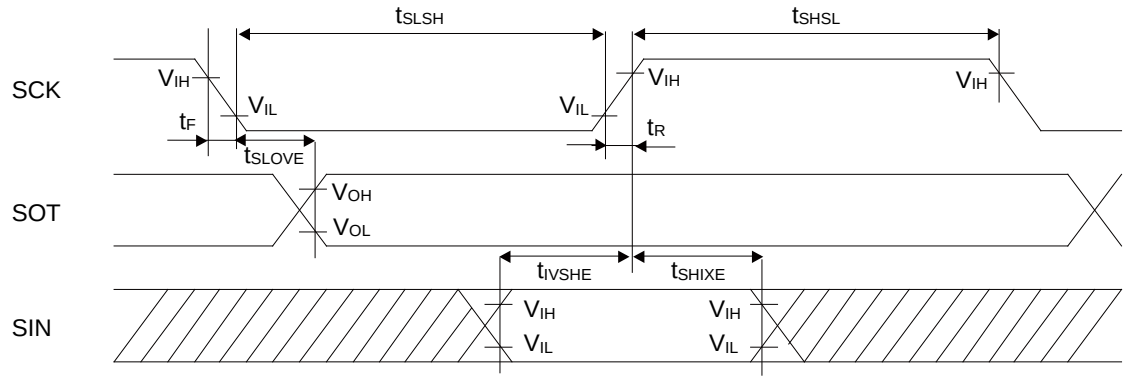
Parameter	Symbol	Pin name	Conditions	V_{CC} < 2.7 V		V_{CC} ≥ 2.7 V		Unit
				Min	Max	Min	Max	
Baud rate	-	-	-	-	8	-	8	Mbps
Serial clock cycle time	t_{SCYC}	SCKx	Master mode	4 t_{CYCP}	-	4 t_{CYCP}	-	ns
SCK ↓ → SOT delay time	t_{SLOVI}	SCKx, SOTx		- 30	+ 30	- 20	+ 20	ns
SIN → SCK ↑ setup time	t_{IVSHI}	SCKx, SINx		50	-	36	-	ns
SCK ↑ → SIN hold time	t_{SHIXI}	SCKx, SINx		0	-	0	-	ns
Serial clock "L" pulse width	t_{SLSH}	SCKx	Slave mode	2 t_{CYCP} - 10	-	2 t_{CYCP} - 10	-	ns
Serial clock "H" pulse width	t_{SHSL}	SCKx		t_{CYCP} + 10	-	t_{CYCP} + 10	-	ns
SCK ↓ → SOT delay time	t_{SLOVE}	SCKx, SOTx		-	50	-	30	ns
SIN → SCK ↑ setup time	t_{IVSHE}	SCKx, SINx		10	-	10	-	ns
SCK ↑ → SIN hold time	t_{SHIXE}	SCKx, SINx		20	-	20	-	ns
SCK falling time	tF	SCKx		-	5	-	5	ns
SCK rising time	tR	SCKx		-	5	-	5	ns

Notes:

- *The above AC characteristics are for clock synchronous mode.*
- *t_{CYCP} indicates the APB bus clock cycle time.*
  For the number of the APB bus to which the Base Timer has been connected, see the Peripheral Address Map.
- *The characteristics are applicable only when the relocate port numbers are the same.*
  For instance, they are not applicable for the combination of SCKx_0 and SOTx_1.
- *External load capacitance C_L=30 pF*



Master mode



Slave mode

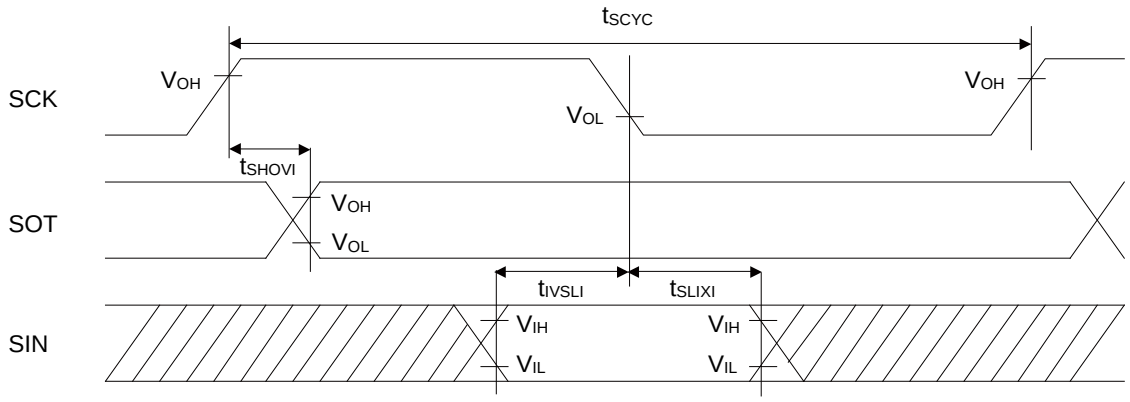
CSIO (SPI=0, SCINV=1)

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

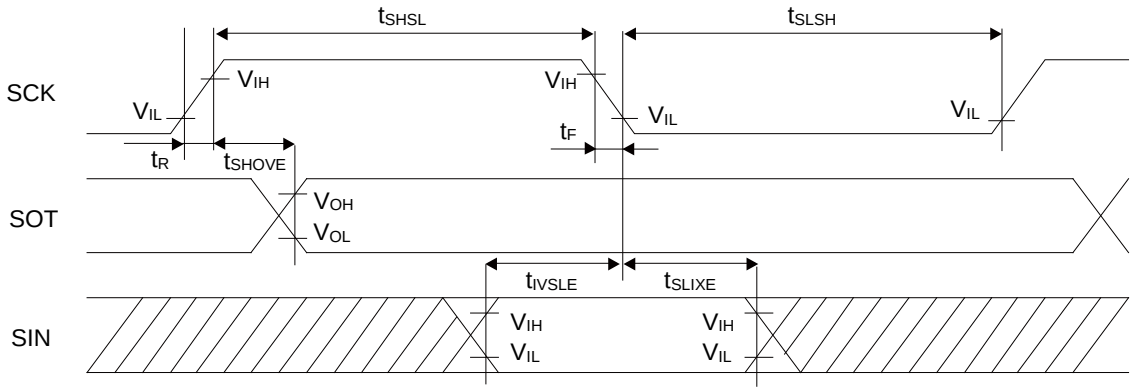
Parameter	Symbol	Pin name	Conditions	V_{CC} < 2.7V		V_{CC} ≥ 2.7V		Unit
				Min	Max	Min	Max	
Baud rate	-	-	-	-	8	-	8	Mbps
Serial clock cycle time	t_{SCYC}	SCKx	Master mode	4 t_{CYCP}	-	4 t_{CYCP}	-	ns
SCK ↑ → SOT delay time	t_{SHOVI}	SCKx, SOTx		- 30	+ 30	- 20	+ 20	ns
SIN → SCK ↓ setup time	t_{IVSLI}	SCKx, SINx		50	-	36	-	ns
SCK ↓ → SIN hold time	t_{SLIXI}	SCKx, SINx		0	-	0	-	ns
Serial clock "L" pulse width	t_{SLSH}	SCKx	Slave mode	2 t_{CYCP} - 10	-	2 t_{CYCP} - 10	-	ns
Serial clock "H" pulse width	t_{SHSL}	SCKx		t_{CYCP} + 10	-	t_{CYCP} + 10	-	ns
SCK ↑ → SOT delay time	t_{SHOVE}	SCKx, SOTx		-	50	-	33	ns
SIN → SCK ↓ setup time	t_{IVSLE}	SCKx, SINx		10	-	10	-	ns
SCK ↓ → SIN hold time	t_{SLIXE}	SCKx, SINx		20	-	20	-	ns
SCK falling time	tF	SCKx		-	5	-	5	ns
SCK rising time	tR	SCKx		-	5	-	5	ns

Notes:

- *The above AC characteristics are for clock synchronous mode.*
- *t_{CYCP} indicates the APB bus clock cycle time.*
  For the number of the APB bus to which the Base Timer has been connected, see the Peripheral Address Map.
- *The characteristics are applicable only when the relocate port numbers are the same.*
  For instance, they are not applicable for the combination of SCKx_0 and SOTx_1.
- *External load capacitance C_L=30 pF*



Master mode



Slave mode

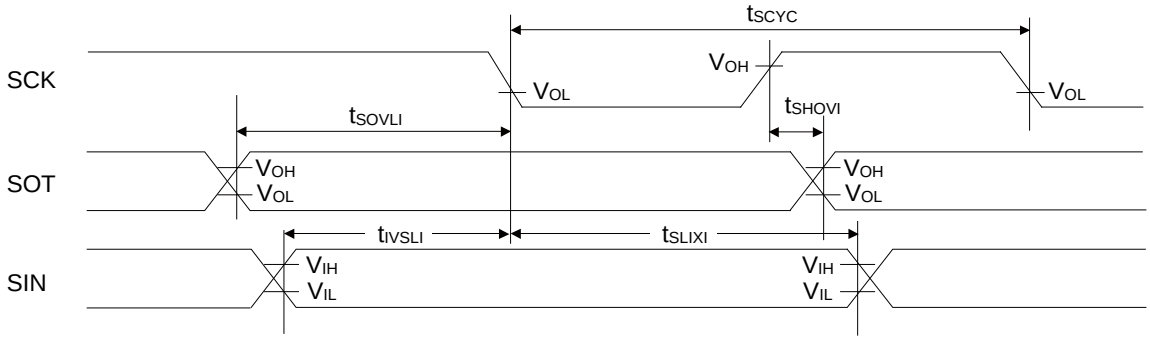
SPI (SPI=1, SCINV=0)

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

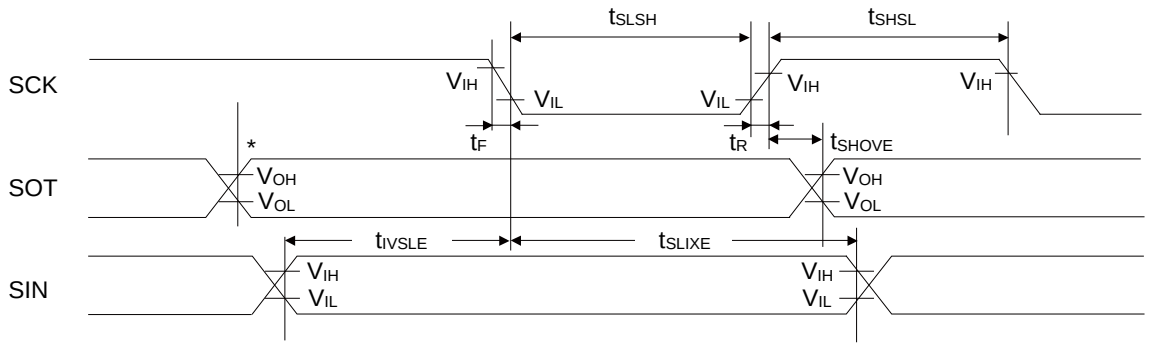
Parameter	Symbol	Pin name	Conditions	V_{CC} < 2.7 V		V_{CC} ≥ 2.7 V		Unit
				Min	Max	Min	Max	
Baud rate	-	-	-	-	8	-	8	Mbps
Serial clock cycle time	t_{SCYC}	SCKx	Master mode	4 t_{CYCP}	-	4 t_{CYCP}	-	ns
SCK ↑ → SOT delay time	t_{SHOVI}	SCKx, SOTx		- 30	+ 30	- 20	+ 20	ns
SIN → SCK ↓ setup time	t_{IVSLI}	SCKx, SINx		50	-	36	-	ns
SCK ↓→ SIN hold time	t_{SLIXI}	SCKx, SINx		0	-	0	-	ns
SOT → SCK ↓ delay time	t_{SOVLI}	SCKx, SOTx		2 t_{CYCP} - 30	-	2 t_{CYCP} - 30	-	ns
Serial clock "L" pulse width	t_{SLSH}	SCKx	Slave mode	2 t_{CYCP} - 10	-	2 t_{CYCP} - 10	-	ns
Serial clock "H" pulse width	t_{SHSL}	SCKx		t_{CYCP} + 10	-	t_{CYCP} + 10	-	ns
SCK ↑ → SOT delay time	t_{SHOVE}	SCKx, SOTx		-	50	-	33	ns
SIN → SCK ↓ setup time	t_{IVSLE}	SCKx, SINx		10	-	10	-	ns
SCK ↓→ SIN hold time	t_{SLIXE}	SCKx, SINx		20	-	20	-	ns
SCK falling time	tF	SCKx		-	5	-	5	ns
SCK rising time	tR	SCKx		-	5	-	5	ns

Notes:

- *The above AC characteristics are for clock synchronous mode.*
- *t_{CYCP} indicates the APB bus clock cycle time.*
  For the number of the APB bus to which the Base Timer has been connected, see the Peripheral Address Map.
- *The characteristics are applicable only when the relocate port numbers are the same.*
  For instance, they are not applicable for the combination of SCKx_0 and SOTx_1.
- *External load capacitance C_L=30 pF*



Master mode



Slave mode

*: Changes when writing to TDR register

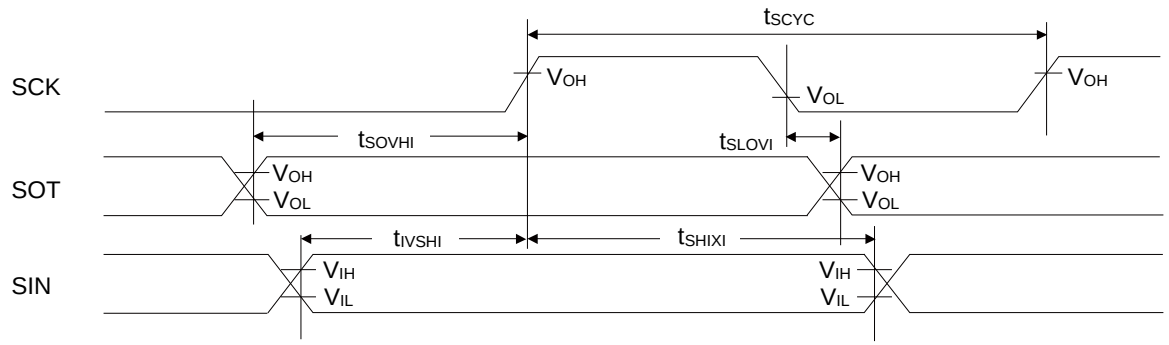
SPI (SPI=1, SCINV=1)

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

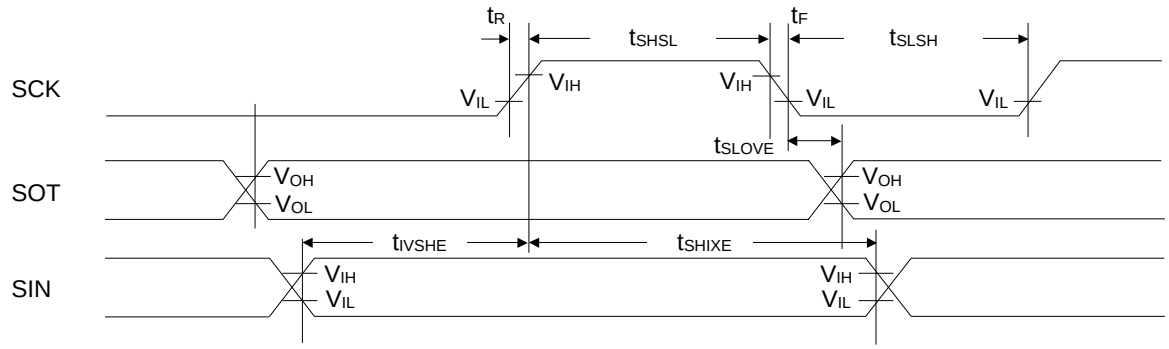
Parameter	Symbol	Pin name	Conditions	V_{CC} < 2.7 V		V_{CC} ≥ 2.7 V		Unit
				Min	Max	Min	Max	
Baud rate	-	-	-	-	8	-	8	Mbps
Serial clock cycle time	t_{SCYC}	SCKx	Master mode	4 t_{CYCP}	-	4 t_{CYCP}	-	ns
SCK ↓ → SOT delay time	t_{SLOVI}	SCKx, SOTx		- 30	+ 30	- 20	+ 20	ns
SIN → SCK ↑ setup time	t_{IVSHI}	SCKx, SINx		50	-	36	-	ns
SCK ↑ → SIN hold time	t_{SHIXI}	SCKx, SINx		0	-	0	-	ns
SOT → SCK ↑ delay time	t_{SOVHI}	SCKx, SOTx		2 t_{CYCP} - 30	-	2 t_{CYCP} - 30	-	ns
Serial clock "L" pulse width	t_{SLSH}	SCKx	Slave mode	2 t_{CYCP} - 10	-	2 t_{CYCP} - 10	-	ns
Serial clock "H" pulse width	t_{SHSL}	SCKx		t_{CYCP} + 10	-	t_{CYCP} + 10	-	ns
SCK ↓ → SOT delay time	t_{SLOVE}	SCKx, SOTx		-	50	-	33	ns
SIN → SCK ↑ setup time	t_{IVSHE}	SCKx, SINx		10	-	10	-	ns
SCK ↑ → SIN hold time	t_{SHIXE}	SCKx, SINx		20	-	20	-	ns
SCK falling time	tF	SCKx		-	5	-	5	ns
SCK rising time	tR	SCKx		-	5	-	5	ns

Notes:

- *The above AC characteristics are for clock synchronous mode.*
- *t_{CYCP} indicates the APB bus clock cycle time.*
  For the number of the APB bus to which the Base Timer has been connected, see the Peripheral Address Map.
- *The characteristics are applicable only when the relocate port numbers are the same.*
  For instance, they are not applicable for the combination of SCKx_0 and SOTx_1.
- *External load capacitance C_L=30 pF*



Master mode



Slave mode

When Using CSIO/SPI Chip Select (SCINV=0, CSLVL=1)

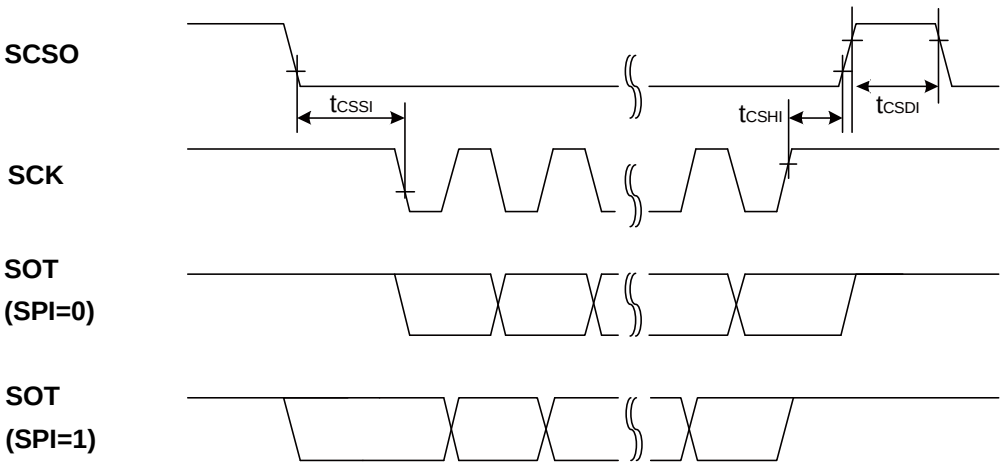
(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Conditions	V_{CC} < 2.7 V		V_{CC} ≥ 2.7 V		Unit
			Min	Max	Min	Max	
SCS↓→SCK↓ setup time	t_{CSSI}	Master mode	-50[43]	+0[43]	-50[43]	+0[43]	ns
SCK↑→SCS↑ hold time	t_{CSHI}		+0[44]	+50[44]	+0[44]	+50[44]	ns
SCS deselect time	t_{CSDI}		-50[45]	+50[44]	-50[44]	+50[44]	ns
SCS↓→SCK↓ setup time	t_{CSSE}	Slave mode	$3t_{CYCP}$+30	-	$3t_{CYCP}$+30	-	ns
SCK↑→SCS↑ hold time	t_{CSHE}		0	-	0	-	ns
SCS deselect time	t_{CSDE}		$3t_{CYCP}$+30	-	$3t_{CYCP}$+30	-	ns
SCS↓→SOT delay time	t_{DSE}		-	55	-	40	ns
SCS↑→SOT delay time	t_{DEE}		0	-	0	-	ns

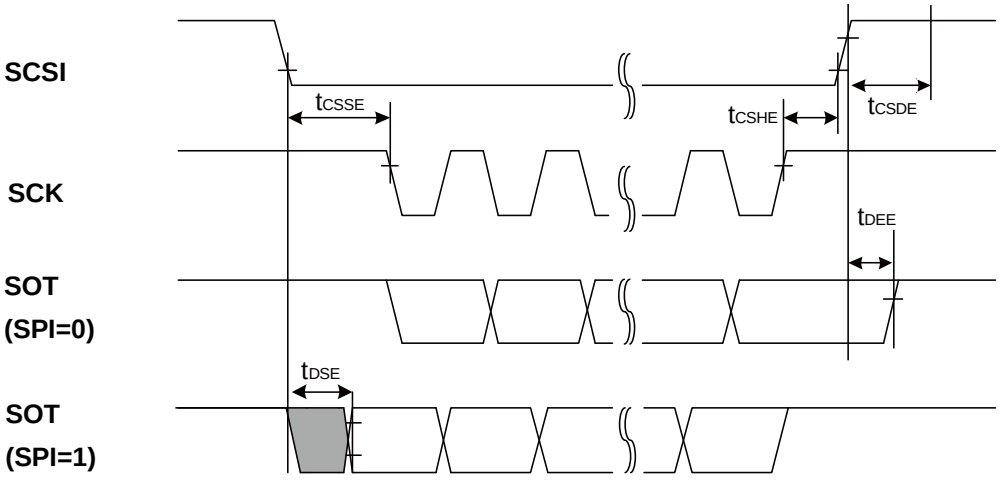
Notes:

- *t_{CYCP} indicates the APB bus clock cycle time.*
  For the number of the APB bus to which the Base Timer has been connected, see the Peripheral Address Map.
- *For information about CSSU, CSHD, CSDS, serial chip select timing operating clock, see "FM0+ Family Peripheral Manual".*
- *These characteristics guarantee only the same relocate port number.*
  For example, the combination of SCKx_0 and SCSIx_1 is not guaranteed.
- *When the external load capacitance C_L=30 pF.*

[43] CSSU bit value × serial chip select timing operating clock cycle.
[44] CSHD bit value × serial chip select timing operating clock cycle.
[45] CSDS bit value × serial chip select timing operating clock cycle.
Irrespective of CSDS bit setting, $5t_{CYCP}$ or more are required for the period the time when the serial chip select pin becomes inactive to the time when the serial chip select pin becomes active again.



Master mode



Slave mode

When Using CSIO/SPI Chip Select (SCINV=1, CSLVL=1)

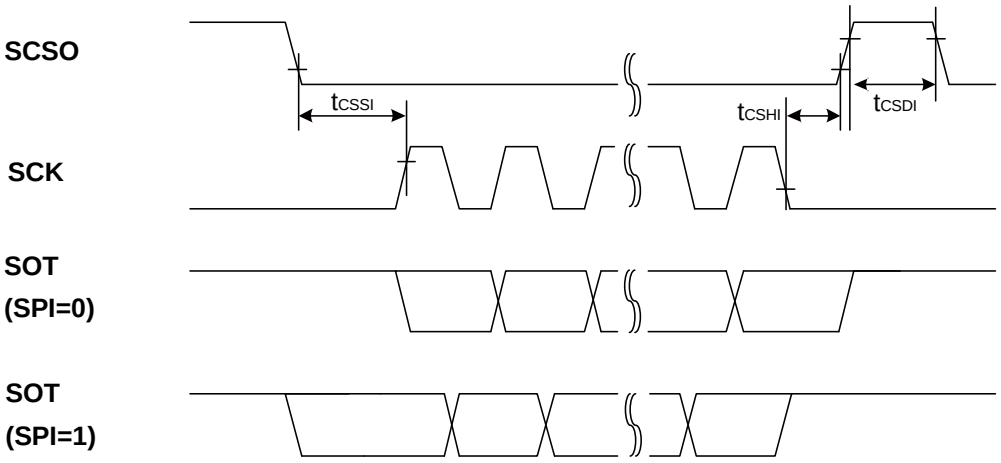
(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Conditions	V_{CC} < 2.7 V		V_{CC} ≥ 2.7 V		Unit
			Min	Max	Min	Max	
SCS↓→SCK↑ setup time	t_{CSSI}	Master mode	-50[46]	+0[46]	-50[46]	+0[46]	ns
SCK↓→SCS↑ hold time	t_{CSHI}		+0[47]	+50[47]	+0[47]	+50[47]	ns
SCS deselect time	t_{CSDI}		-50[48]	+50[48]	-50[48]	+50[48]	ns
SCS↓→SCK↑ setup time	t_{CSSE}	Slave mode	3t_{CYCP}+30	-	3t_{CYCP}+30	-	ns
SCK↓→SCS↑ hold time	t_{CSHE}		0	-	0	-	ns
SCS deselect time	t_{CSDE}		3t_{CYCP}+30	-	3t_{CYCP}+30	-	ns
SCS↓→SOT delay time	t_{DSE}		-	55	-	40	ns
SCS↑→SOT delay time	t_{DEE}		0	-	0	-	ns

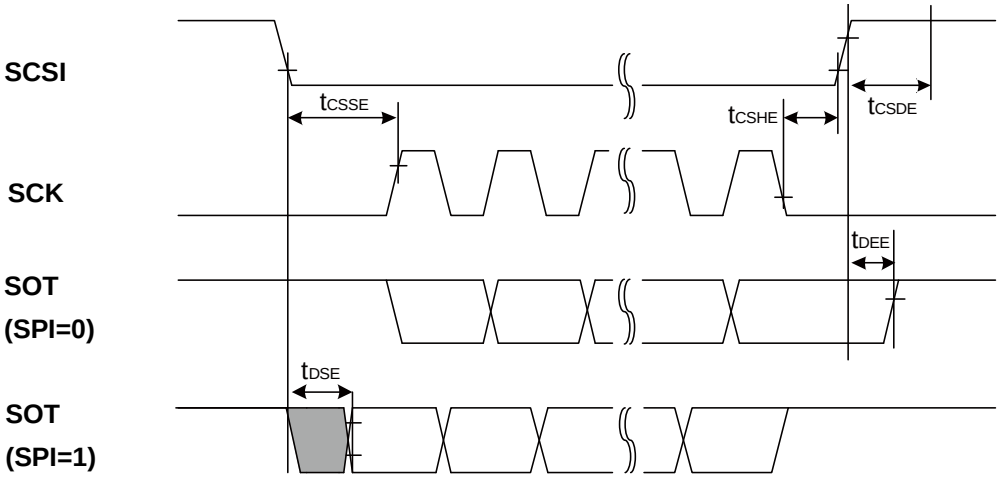
Notes:

- *t_{CYCP} indicates the APB bus clock cycle time.*
  For the number of the APB bus to which the Base Timer has been connected, see the Peripheral Address Map.
- *For information about CSSU, CSHD, CSDS, serial chip select timing operating clock, see "FM0+ Family Peripheral Manual".*
- *These characteristics guarantee only the same relocate port number.*
  For example, the combination of SCKx_0 and SCSIx_1 is not guaranteed.
- *When the external load capacitance C_L=30 pF.*

[46] CSSU bit value × serial chip select timing operating clock cycle.
[47] CSHD bit value × serial chip select timing operating clock cycle.
[48] CSDS bit value × serial chip select timing operating clock cycle.
Irrespective of CSDS bit setting, 5t_{CYCP} or more are required for the period the time when the serial chip select pin becomes inactive to the time when the serial chip select pin becomes active again.



Master mode



Slave mode

When Using CSIO/SPI Chip Select (SCINV=0, CSLVL=0)

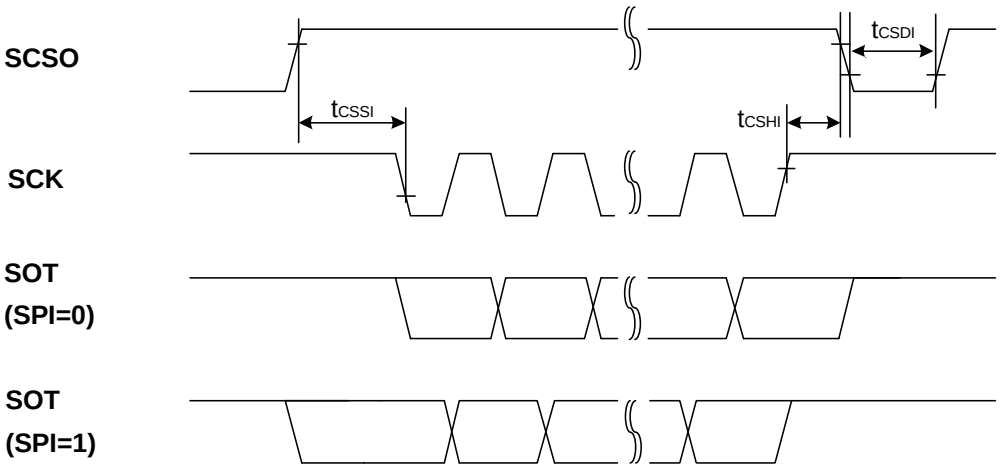
(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Conditions	V_{CC} < 2.7 V		V_{CC} ≥ 2.7 V		Unit
			Min	Max	Min	Max	
SCS↑→SCK↓ setup time	t_{CSSI}	Master mode	-50[49]	+0[49]	-50[49]	+0[49]	ns
SCK↑→SCS↓ hold time	t_{CSHI}		+0[50]	+50[50]	+0[50]	+50[50]	ns
SCS deselect time	t_{CSDI}		-50[51]	+50[51]	-50[51]	+50[51]	ns
SCS↑→SCK↓ setup time	t_{CSSE}	Slave mode	3t_{CYCP}+30	-	3t_{CYCP}+30	-	ns
SCK↑→SCS↓ hold time	t_{CSHE}		0	-	0	-	ns
SCS deselect time	t_{CSDE}		3t_{CYCP}+30	-	3t_{CYCP}+30	-	ns
SCS↑→SOT delay time	t_{DSE}		-	55	-	40	ns
SCS↓→SOT delay time	t_{DEE}		0	-	0	-	ns

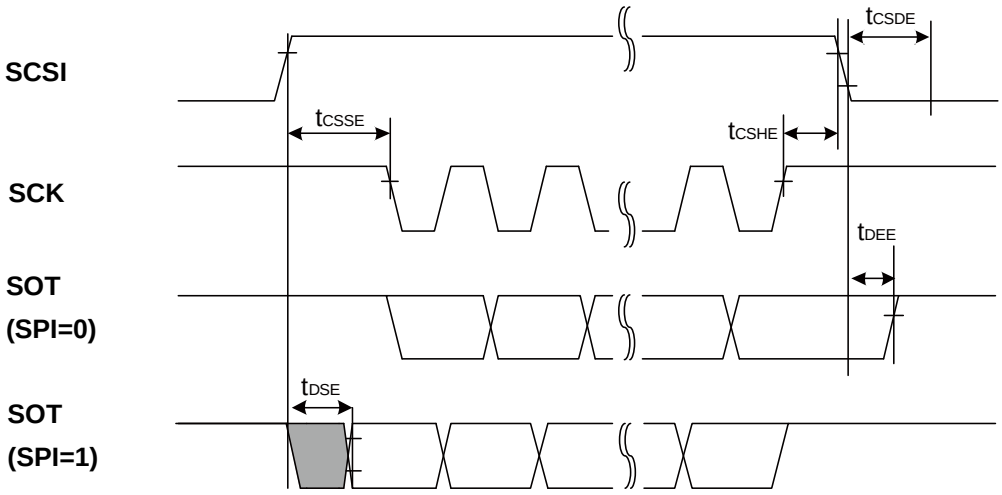
Notes:

- *t_{CYCP} indicates the APB bus clock cycle time.*
  For the number of the APB bus to which the Base Timer has been connected, see the Peripheral Address Map.
- *For information About CSSU, CSHD, CSDS, serial chip select timing operating clock, see "FM0+ Family Peripheral Manual".*
- *These characteristics guarantee only the same relocate port number.*
  For example, the combination of SCKx_0 and SCSIx_1 is not guaranteed.
- *When the external load capacitance C_L=30 pF.*

[49] CSSU bit value × serial chip select timing operating clock cycle.
[50] CSHD bit value × serial chip select timing operating clock cycle.
[51] CSDS bit value × serial chip select timing operating clock cycle.
Irrespective of CSDS bit setting, 5t_{CYCP} or more are required for the period the time when the serial chip select pin becomes inactive to the time when the serial chip select pin becomes active again.



Master mode



Slave mode

When Using CSIO/SPI Chip Select (SCINV=1, CSLVL=0)

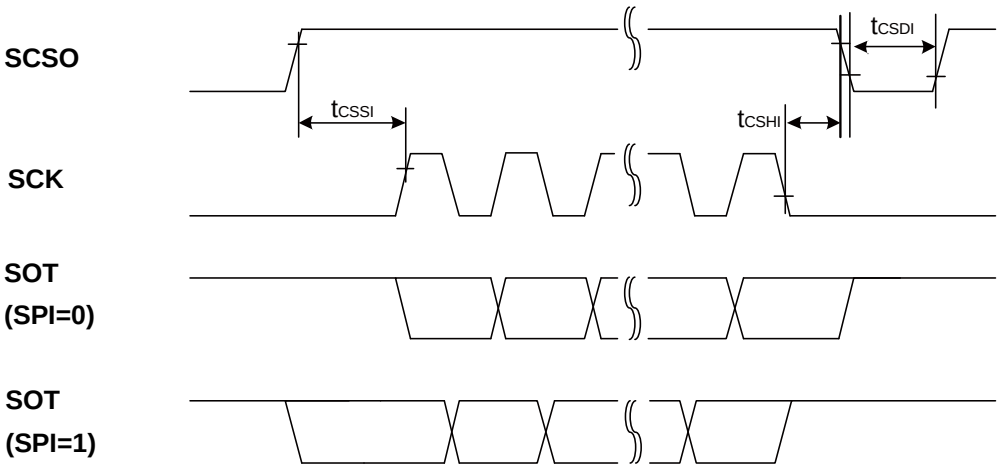
(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Conditions	V_{CC} < 2.7 V		V_{CC} ≥ 2.7 V		Unit
			Min	Max	Min	Max	
SCS↑→SCK↑ setup time	t_{CSSI}	Master mode	-50[52]	+0[52]	-50[52]	+0[52]	ns
SCK↓→SCS↓ hold time	t_{CSHI}		+0[53]	+50[53]	+0[53]	+50[53]	ns
SCS deselect time	t_{CSDI}		-50[54]	+50[54]	-50[54]	+50[54]	ns
SCS↑→SCK↑ setup time	t_{CSSE}	Slave mode	$3t_{CYCP}$+30	-	$3t_{CYCP}$+30	-	ns
SCK↓→SCS↓ hold time	t_{CSHE}		0	-	0	-	ns
SCS deselect time	t_{CSDE}		$3t_{CYCP}$+30	-	$3t_{CYCP}$+30	-	ns
SCS↑→SOT delay time	t_{DSE}		-	55	-	40	ns
SCS↓→SOT delay time	t_{DEE}		0	-	0	-	ns

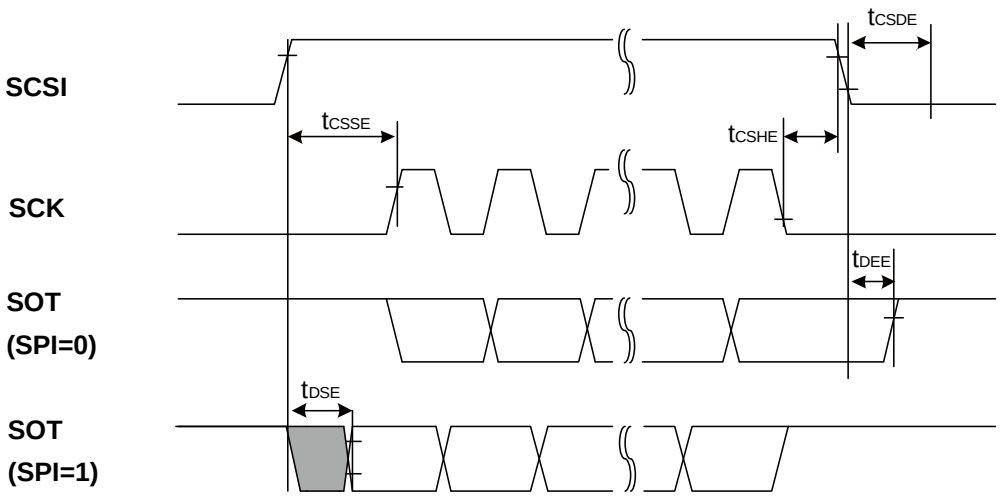
Notes:

- *t_{CYCP} indicates the APB bus clock cycle time.*
  For the number of the APB bus to which the Base Timer has been connected, see the Peripheral Address Map.
- *For information about CSSU, CSHD, CSDS, serial chip select timing operating clock, see "FM0+ Family Peripheral Manual".*
- *These characteristics guarantee only the same relocate port number.*
  For example, the combination of SCKx_0 and SCSIx_1 is not guaranteed.
- *When the external load capacitance C_L=30 pF.*

[52] CSSU bit value × serial chip select timing operating clock cycle.
[53] CSHD bit value × serial chip select timing operating clock cycle.
[54] CSDS bit value × serial chip select timing operating clock cycle.
Irrespective of CSDS bit setting, $5t_{CYCP}$ or more are required for the period the time when the serial chip select pin becomes inactive to the time when the serial chip select pin becomes active again.



Master mode

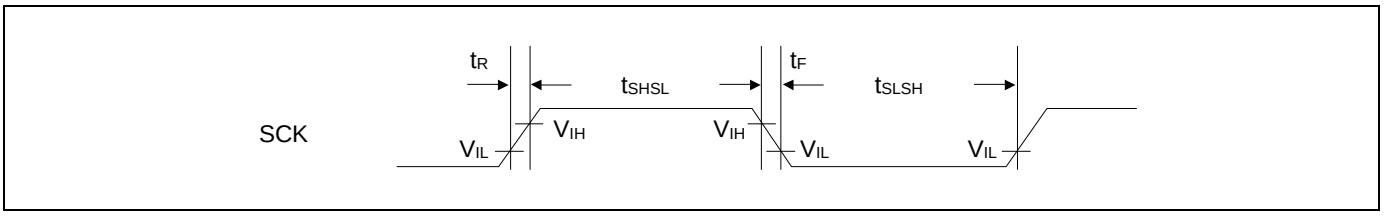


Slave mode

UART external clock input (EXT=1)

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

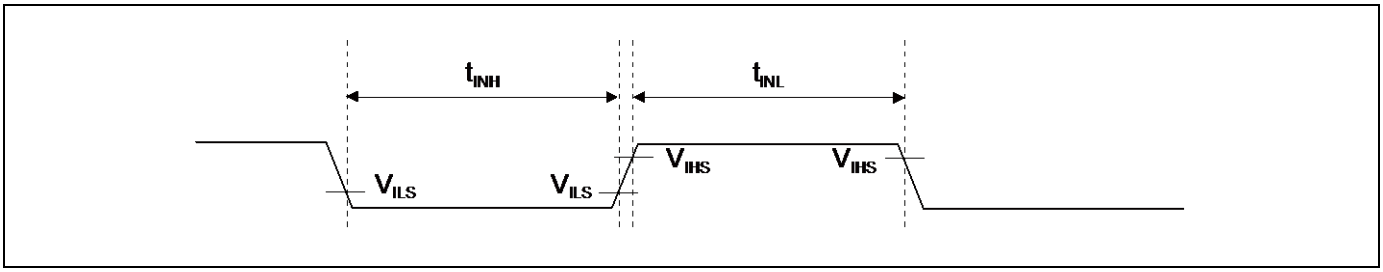
Parameter	Symbol	Conditions	Value		Unit	Remarks
			Min	Max		
Serial clock L pulse width	t_{SLSH}	C_L=30 pF	t_{CYCP} +10	-	ns	
Serial clock H pulse width	t_{SHSL}		t_{CYCP} +10	-	ns	
SCK falling time	t_F		-	5	ns	
SCK rising time	t_R		-	5	ns	



11.4.10 External Input Timing

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Conditions	Value		Unit	Remarks
				Min	Max		
Input pulse width	t_{INH}, t_{INL}	ADTGx	-	2 t_{CYCP}[55]	-	ns	A/D converter trigger input
		INT00 to INT08, INT12, INT13, INT15, NMIX	[56]	2 t_{CYCP} +100[55]	-	ns	External interrupt, NMI
			[57]	500	-	ns	
		WKUPx	[58]	500	-	ns	Deep standby wake up



[55] t_{CYCP} indicates the APB bus clock cycle time. For the number of the APB bus to which the Base Timer has been connected, see the Peripheral Address Map.
[56] In Run mode and Sleep mode
[57] In Timer mode, RTC mode and Stop mode
[58] In Deep Standby RTC mode and Deep Standby Stop mode

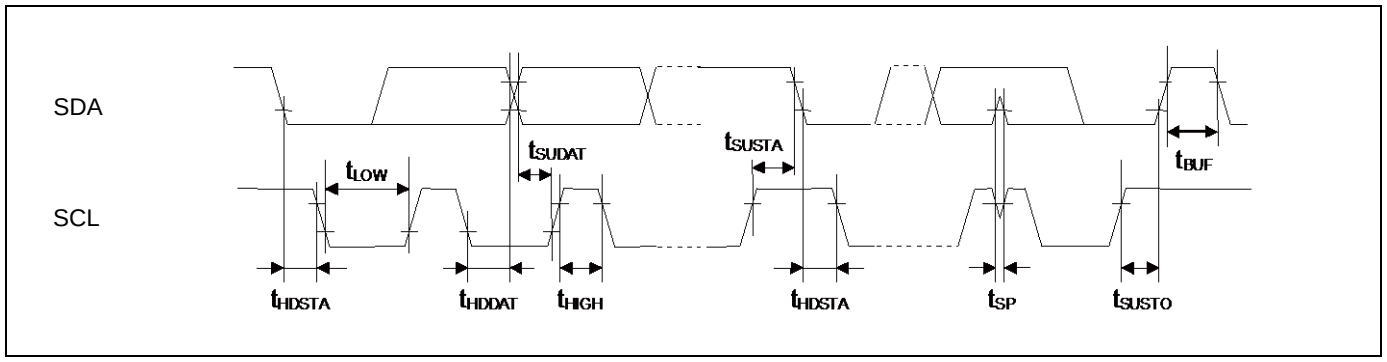
11.4.11 I²C Timing

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Conditions	Standard-Mode		Fast-Mode		Unit	Remarks
			Min	Max	Min	Max		
SCL clock frequency	F_{SCL}	C_L=30 pF, R=(Vp/I_{OL})[59]	0	100	0	400	kHz	
(Repeated) Start condition hold time SDA ↓ → SCL ↓	t_{HDSTA}		4.0	-	0.6	-	µs	
SCL clock L width	t_{LOW}		4.7	-	1.3	-	µs	
SCL clock H width	t_{HIGH}		4.0	-	0.6	-	µs	
(Repeated) Start setup time SCL ↑ → SDA ↓	t_{SUSTA}		4.7	-	0.6	-	µs	
Data hold time SCL ↓ → SDA ↓ ↑	t_{HDDAT}		0	3.45[60]	0	0.9[61]	µs	
Data setup time SDA ↓ ↑ → SCL ↑	t_{SUDAT}		250	-	100	-	ns	
Stop condition setup time SCL ↑ → SDA ↑	t_{SUSTO}		4.0	-	0.6	-	µs	
Bus free time between Stop condition and Start condition	t_{BUF}		4.7	-	1.3	-	µs	
Noise filter	t_{SP}	-	2 t_{CYCP}[62]	-	2 t_{CYCP}[62]	-	ns	

".

To use Standard-mode, set the APB bus clock at 2 MHz or more.
To use Fast-mode, set the APB bus clock at 8 MHz or more.



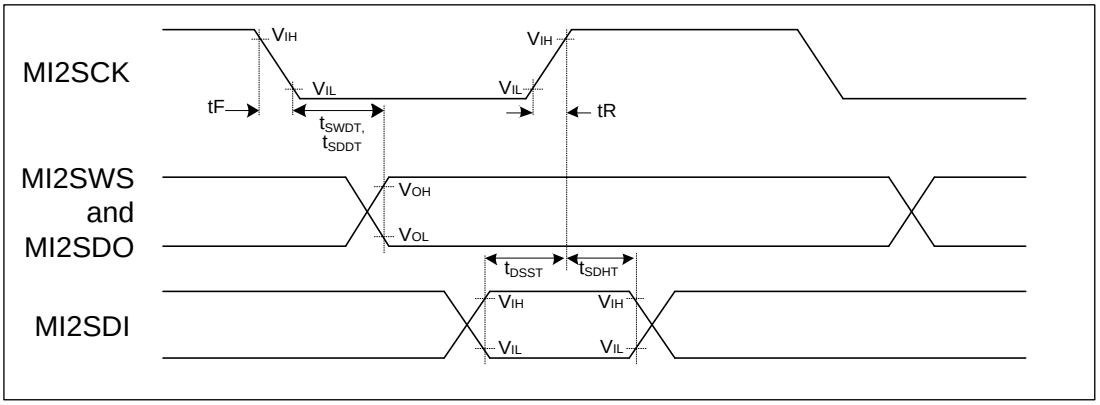
[59] R represents the pull-up resistance of the SCL and SDA lines, and C_L the load capacitance of the SCL and SDA lines. V_P represents the power supply voltage of the pull-up resistance, and I_{OL} the V_{OL} guaranteed current.
[60] The maximum t_{HDDAT} must satisfy at least the condition that the period during which the device is holding the SCL signal at L (t_{LOW}) does not extend.
[61] A Fast-mode I²C bus device can be used in a Standard-mode I²C bus system, provided that the condition of t_{SUDAT} ≥ 250 ns is fulfilled.
[62] t_{CYCP} represents the APB bus clock cycle time. For the number of the APB bus to which the Base Timer has been connected, see the Peripheral Address Map.

11.4.12 I²S Timing (MFS-I2S Timing)

Master Mode Timing

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Conditions	V_{CC} < 2.7 V		V_{CC} ≥ 2.7 V		Unit
				Min	Max	Min	Max	
MI2SCK max frequency[63]	F_{MI2SCK}	MI2SCKx	C_L=30 pF	-	6.144	-	6.144	MHz
I²S clock cycle time[63]	t_{ICYC}	MI2SCKx		4 t_{CYCP}	-	4 t_{CYCP}	-	ns
I²S clock Duty cycle	Δ	MI2SCKx		45%	55%	45%	55%	
MI2SCK ↓ → MI2SWS delay time	t_{SWDT}	MI2SCKx, MI2SWSx		-30	+30	-20	+20	ns
MI2SCK ↓ → MI2SDO delay time	t_{SDDT}	MI2SCKx, MI2SDOx		-30	+30	-20	+20	ns
MI2SDI → MI2SCK ↑ setup time	t_{DSST}	MI2SCKx, MI2SDIx		50	-	36	-	ns
MI2SCK ↑ → MI2SDI hold time	t_{SDHT}	MI2SCKx, MI2SDIx		0	-	0	-	ns
MI2SCK falling time	tF	MI2SCKx		-	5	-	5	ns
MI2SCK rising time	tR	MI2SCKx		-	5	-	5	ns

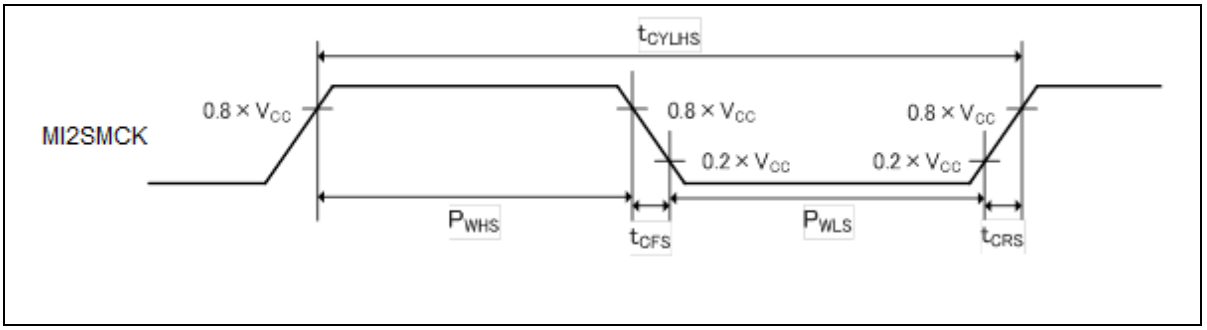


[63] I²S clock should meet the multiple of PCLK(t_{ICYC}) and the frequency less than F_{MI2SCK} meantime. The detail information please refer to Chapter I²S of Communication Macro Part of the Peripheral Manual.

MI2SMCK Input Characteristics

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Conditions	Value		Unit	Remarks
				Min	Max		
Input frequency	f_{CHS}	MI2SMCK	-	-	12.288	MHz	
Input clock cycle	t_{CYLHS}	-	-	81.3	-	ns	
Input clock pulse width	-	-	P_{WHS}/t_{CYLHS} P_{WLS}/t_{CYLHS}	45	55	%	When using external clock
Input clock rise time and fall time	t_{CFS} t_{CRS}	-	-	-	5	ns	When using external clock



MI2SMCK Output Characteristics

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Conditions	Value		Unit	Remarks
				Min	Max		
Output frequency	f_{CHS}	MI2SMCK	-	-	25	MHz	$V_{CC} \geq 2.7$ V
				-	20	MHz	$V_{CC} < 2.7$ V

11.4.13 Smart Card Interface Characteristics

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Conditions	Value		Unit	Remarks
				Min	Max		
Output rising time	t_R	ICx_VCC, ICx_RST, ICx_CLK, ICx_DATA	C_L=30 pF	4	20	ns	
Output falling time	t_F			4	20	ns	
Output clock frequency	f_{CLK}	ICx_CLK		-	20	MHz	
Duty cycle	Δ			45%	55%		

■External pull-up resistor (20 kΩ to 50 kΩ) must be applied to ICx_CIN pin when it's used as smart card reader function.

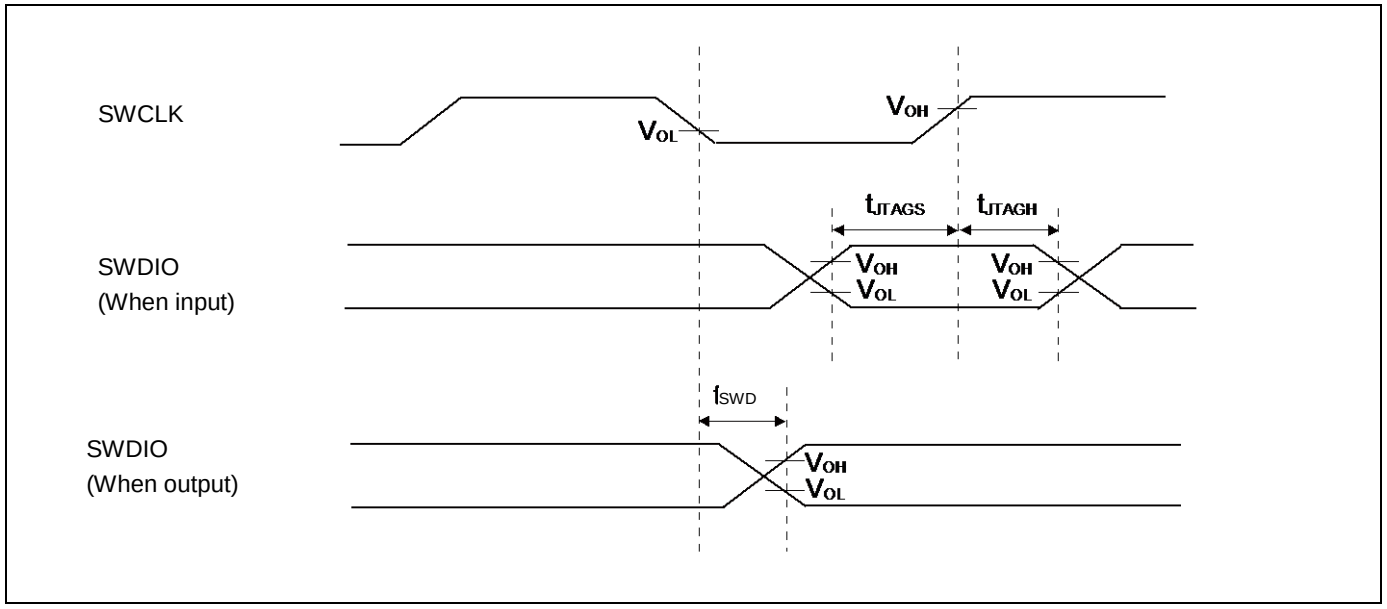
11.4.14 SW-DP Timing

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Conditions	Value		Unit	Remarks
				Min	Max		
SWDIO setup time	t_{SWS}	SWCLK, SWDIO	-	15	-	ns	
SWDIO hold time	t_{SWH}	SWCLK, SWDIO	-	15	-	ns	
SWDIO delay time	t_{SWD}	SWCLK, SWDIO	-	-	45	ns	

Note:

- *External load capacitance C_L=30 pF*



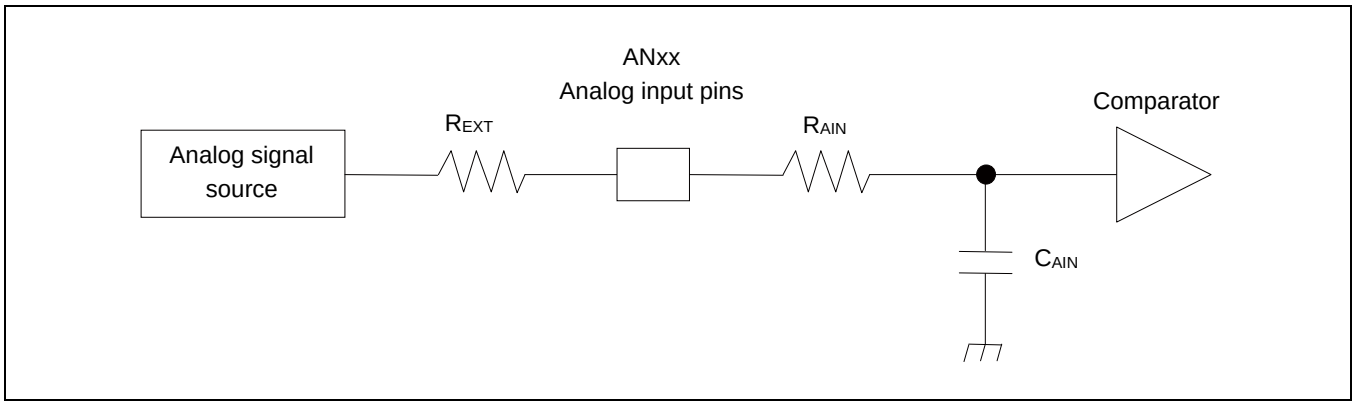
11.5 12-bit A/D Converter

Electrical Characteristics of A/D Converter (Preliminary Values)

(V_{CC}= 1.65 V to 3.6 V, V_{SS}= 0 V, T_A=- 40°C to +105°C)

Parameter	Symbol	Pin Name	Value			Unit	Remarks
			Min	Typ	Max		
Resolution	-	-	-	-	12	bit	
Integral Nonlinearity	-	-	- 4.5	-	4.5	LSB	
Differential Nonlinearity	-	-	- 2.5	-	+ 2.5	LSB	
Zero transition voltage	V_{ZT}	ANxx	- 15	-	+ 15	mV	
Full-scale transition voltage	V_{FST}	ANxx	AVRH - 15	-	AVRH + 15	mV	
Conversion time[64]	-	-	1.0	-	-	µs	$V_{CC} \geq$ 2.7 V
			4.0	-	-		1.8 ≤ V_{CC} < 2.7 V
			10	-	-		1.65 ≤ V_{CC} < 1.8 V
Sampling time[65]	Ts	-	0.3	-	10	µs	$V_{CC} \geq$ 2.7 V
			1.2	-			1.8 ≤ V_{CC} < 2.7 V
			3.0	-			1.65 ≤ V_{CC} < 1.8 V
Compare clock cycle[66]	Tcck	-	50	-	1000	ns	$V_{CC} \geq$ 2.7 V
			200	-			1.8 ≤ V_{CC} < 2.7 V
			500	-			1.65 ≤ V_{CC} < 1.8 V
State transition time to operation permission	Tstt	-	-	-	1.0	µs	
Analog input capacity	C_{AIN}	-	-	-	7.5	pF	
Analog input resistance	R_{AIN}	-	-	-	2.2	kΩ	$V_{CC} \geq$ 2.7 V
					5.5		1.8 ≤ V_{CC} < 2.7 V
					10.5		1.65 ≤ V_{CC} < 1.8 V
Interchannel disparity	-	-	-	-	4	LSB	
Analog port input leak current	-	ANxx	-	-	5	µA	
Analog input voltage	-	ANxx	V_{SS}	-	AVRH	V	
Reference voltage	-	AVRH	2.7	-	V_{CC}	V	VCC ≥ 2.7V
			V_{CC}				VCC < 2.7V
	-	AVRL	V_{SS}	-	V_{SS}	V	

[64] The conversion time is the value of sampling time (t_S) + compare time (t_C).
The minimum conversion time is computed according to the following conditions:
$V_{CC} \geq$ 2.7 V sampling time=0.3 µs, compare time=0.7 µs
1.8 ≤ V_{CC} < 2.7 V sampling time=1.2 µs, compare time=2.8 µs
1.65 ≤ V_{CC} < 1.8 V sampling time=3.0 µs, compare time=7.0 µs
Ensure that the conversion time satisfies the specifications of the sampling time (t_S) and compare clock cycle (t_{CCK}).
For details of the settings of the sampling time and compare clock cycle, refer to "Chapter: A/D Converter" in "FM0+ Family Peripheral Manual Analog Macro Part".
The register settings of the A/D Converter are reflected in the operation according to the APB bus clock timing.
For the number of the APB bus to which the A/D Converter is connected, see the Peripheral Address Map.
The base clock (HCLK) is used to generate the sampling time and the compare clock cycle.
[65] The required sampling time varies according to the external impedance. Set a sampling time that satisfies (Equation 1).
[66] The compare time (t_C) is the result of (Equation 2).



(Equation 1) $t_S \geq (R_{AIN} + R_{EXT}) \times C_{AIN} \times 9$

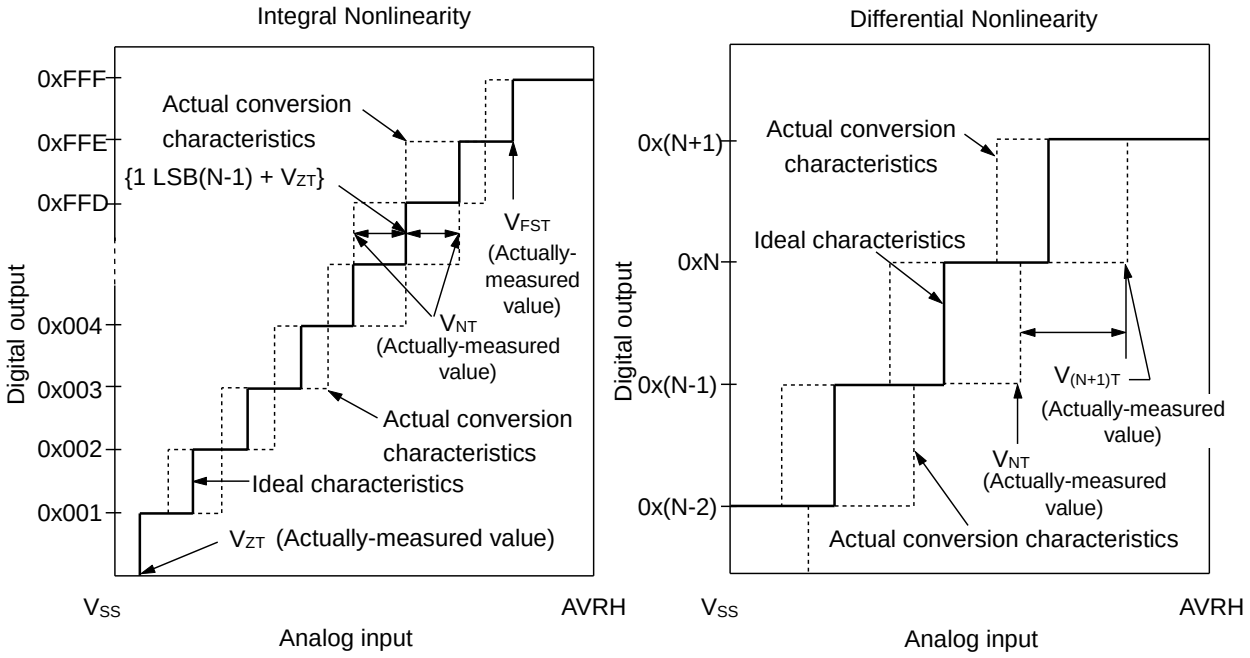
t_S:	Sampling time
R_{AIN}:	Input resistance of A/D Converter = 2.2 kΩ with 2.7 ≤ VCC ≤ 3.6
	Input resistance of A/D Converter = 5.5 kΩ with 1.8 ≤ VCC ≤ 2.7
	Input resistance of A/D Converter = 10.5 kΩ with 1.65 ≤ VCC ≤ 1.8
C_{AIN}:	Input capacitance of A/D Converter = 7.5 pF with 1.65 ≤ VCC ≤ 3.6
R_{EXT}:	Output impedance of external circuit

(Equation 2) $t_C = t_{CCK} \times 14$

t_C:	Compare time
t_{CCK} :	Compare clock cycle

Definitions of 12-bit A/D Converter Terms

- Resolution: Analog variation that is recognized by an A/D converter.
- Integral Nonlinearity: Deviation of the line between the zero-transition point (0b000000000000 ⟷ 0b000000000001) and the full-scale transition point (0b111111111110 ⟷ 0b111111111111) from the actual conversion characteristics.
- Differential Nonlinearity: Deviation from the ideal value of the input voltage that is required to change the output code by 1 LSB.



$$\text{Integral Nonlinearity of digital output N} = \frac{V_{NT} - \{1LSB \times (N - 1) + V_{ZT}\}}{1LSB} \text{ [LSB]}$$

$$\text{Differential Nonlinearity of digital output N} = \frac{V_{(N+1)T} - V_{NT}}{1LSB} - 1 \text{ [LSB]}$$

$$1LSB = \frac{V_{FST} - V_{ZT}}{4094}$$

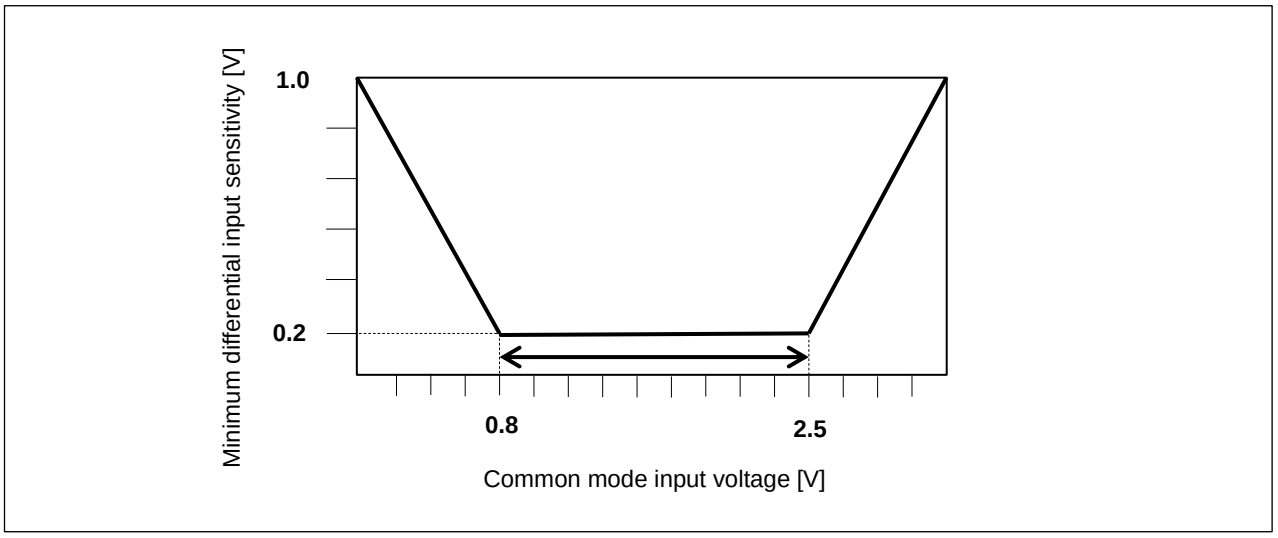
N : A/D converter digital output value.
V_{ZT} : Voltage at which the digital output changes from 0x000 to 0x001.
V_{FST} : Voltage at which the digital output changes from 0xFFE to 0xFFF.
V_{NT} : Voltage at which the digital output changes from 0x(N − 1) to 0xN.

11.6 USB Characteristics

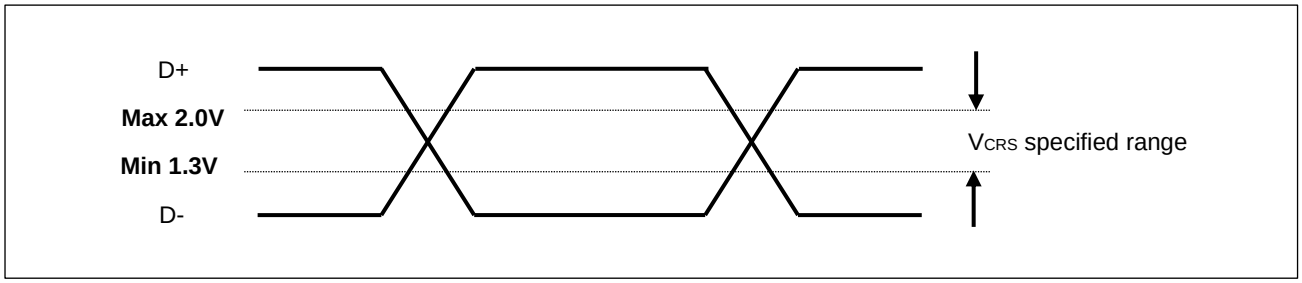
(V_{CC}=3.0 V to 3.6 V, V_{SS}=0 V, T_A=- 40°C to +105°C)

Parameter		Symbol	Pin Name	Conditions	Value		Unit	Schematic Reference
					Min	Max		
Input characteristics	Input H level voltage	V_{IH}	UDP0, UDM0	-	2.0	V_{CC} + 0.3	V	1
	Input L level voltage	V_{IL}		-	V_{SS} – 0.3	0.8	V	1
	Differential input sensitivity	V_{DI}		-	0.2	-	V	2
	Differential common mode range	V_{CM}		-	0.8	2.5	V	2
Output characteristic	Output H level voltage	V_{OH}		External pull-down resistance = 15 kΩ	2.8	3.6	V	3
	Output L level voltage	V_{OL}		External pull-up resistance = 1.5 kΩ	0.0	0.3	V	3
	Crossover voltage	V_{CRS}		-	1.3	2.0	V	4
	Rising time	t_{FR}		Full-speed	4	20	ns	5
	Falling time	t_{FF}		Full-speed	4	20	ns	5
	Rising/Falling time matching	t_{FRFM}		Full-speed	90	111.11	%	5
	Output impedance	Z_{DRV}		Full-speed	28	44	Ω	6
	Rising time	t_{LR}		Low-speed	75	300	ns	7
	Falling time	t_{LF}		Low-speed	75	300	ns	7
	Rising/Falling time matching	t_{LRFM}		Low-speed	80	125	%	7

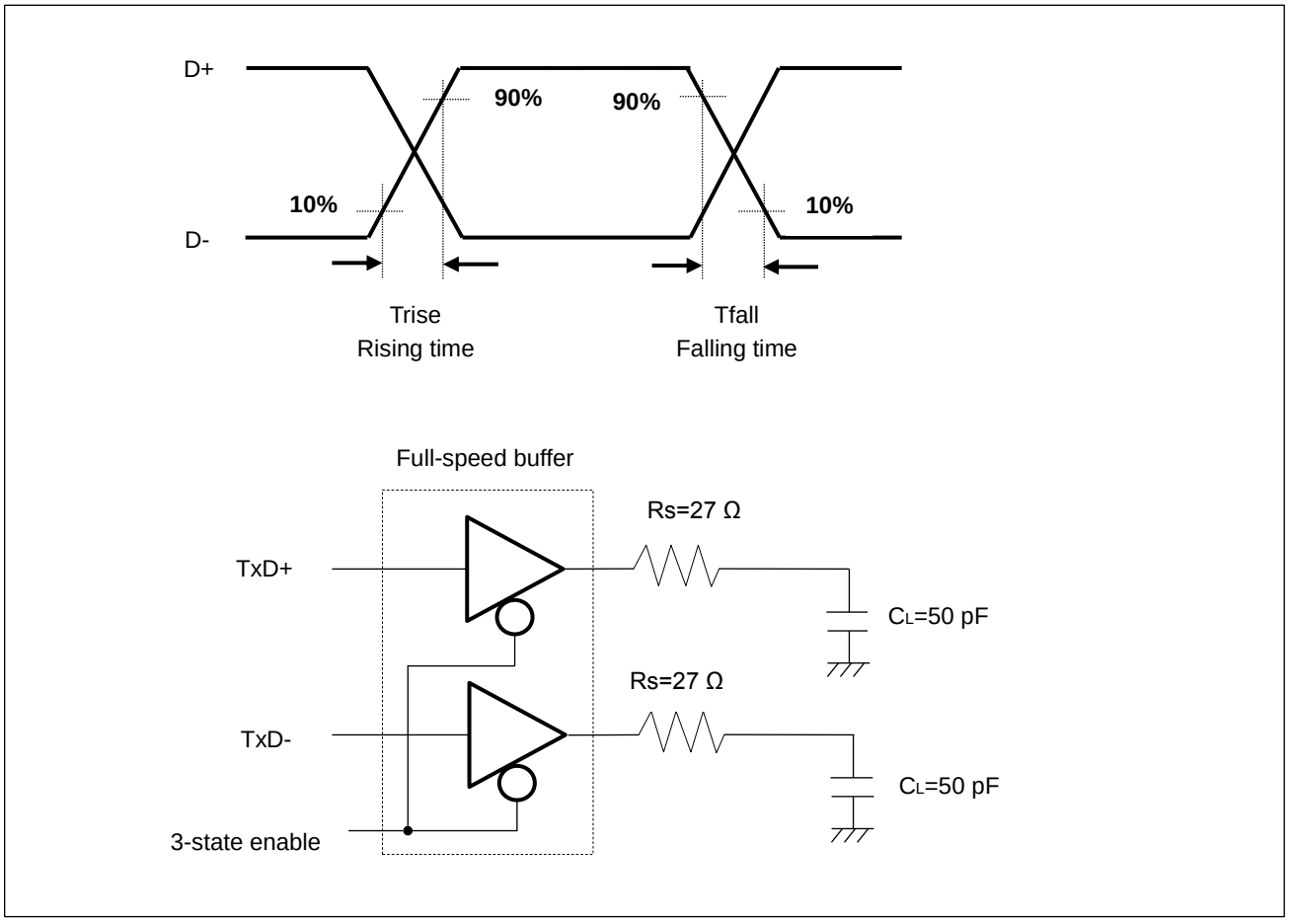
1. The switching threshold voltage of single-end-receiver of USB I/O buffer is set as within V_{IL}(Max)=0.8 V, VIH(Min)=2.0 V (TTL input standard).
   There is some hysteresis to lower noise sensitivity.
2. Use differential-receiver to receive USB differential data signal.
   Differential-receiver has 200 mV of differential input sensitivity when the differential data input is within 0.8 V to 2.5 V to the local ground reference level.
   Above voltage range is the common mode input voltage range.



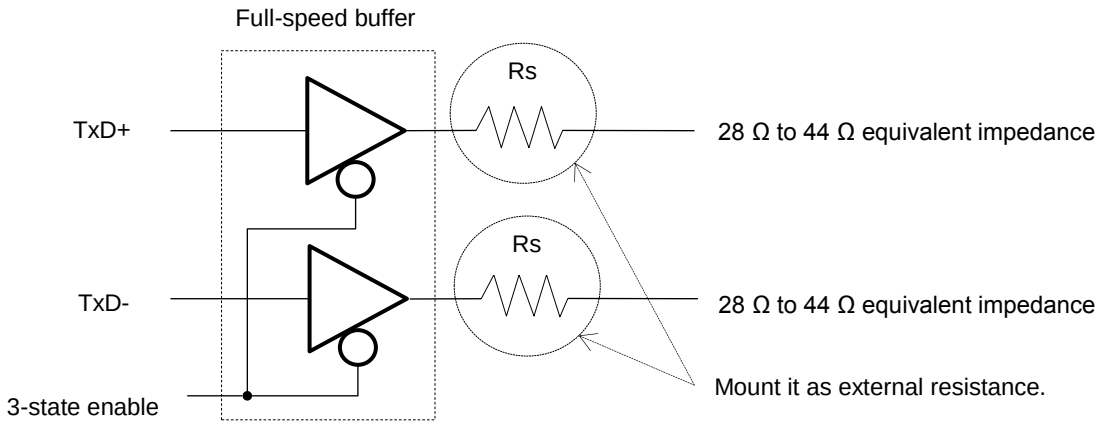
3. The output drive capability of the driver is below 0.3 V at Low-state (V_{OL}) (to 3.6 V and 1.5 kΩ load), and 2.8 V or above (to the VSS and 1.5 kΩ load) at high-state (V_{OH})
4. The cross voltage of the external differential output signal (D+ / D-) of USB I/O buffer is within 1.3 V to 2.0 V.



5. They indicate rising time (Trise) and falling time (Tfall) of the full-speed differential data signal.
   They are defined by the time between 10% and 90% of the output signal voltage.
   For full-speed buffer, Tr/Tf ratio is regulated as within ±10% to minimize RFI emission.

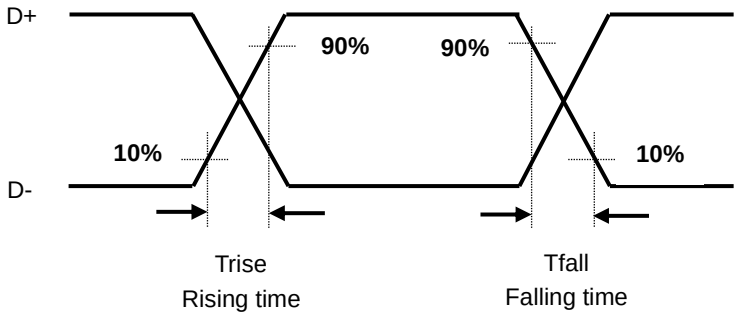


6. USB Full-speed connection is performed via twist pair cable shield with 90 Ω ± 15% characteristic impedance (Differential Mode).
   USB standard defines that output impedance of USB driver must be in range from 28 Ω to 44 Ω. So, discrete series resistor (Rs) addition is defined to satisfy the above definition and keep balance.
   When using this USB I/O, use it with 25 Ω to 33 Ω (recommendation value: 27 Ω) series resistor Rs.



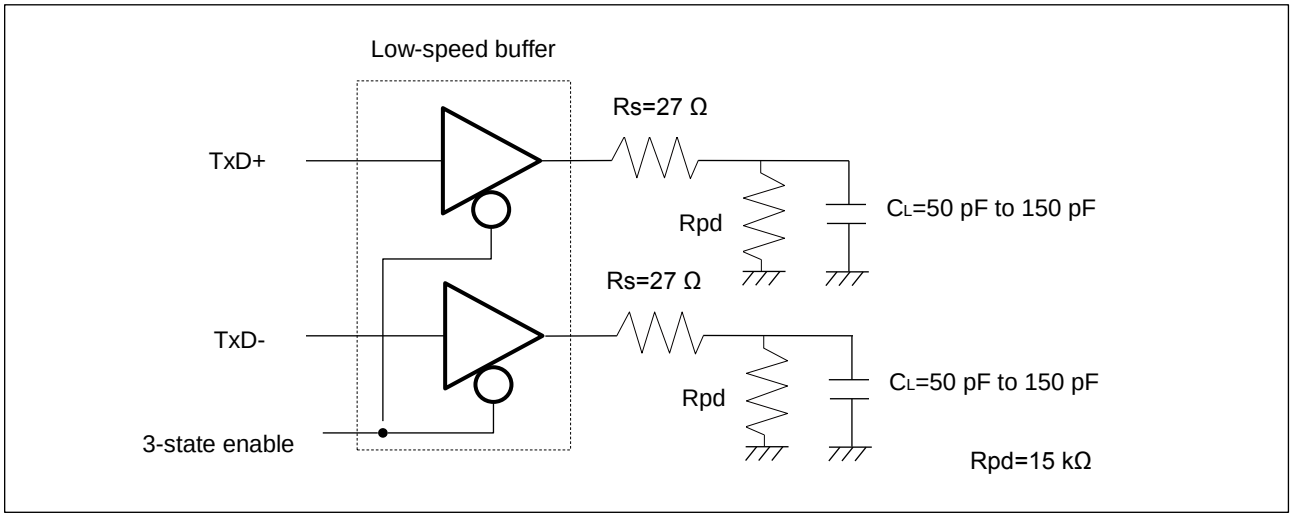
Rs series resistor 25 Ω to 30 Ω
Series resistor of 27 Ω (recommendation value) must be added.
And, use “resistance with an uncertainty of 5% by E24 sequence”.

7. They indicate rising time (Trise) and falling time (Tfall) of the low-speed differential data signal.
   They are defined by the time between 10% and 90% of the output signal voltage.

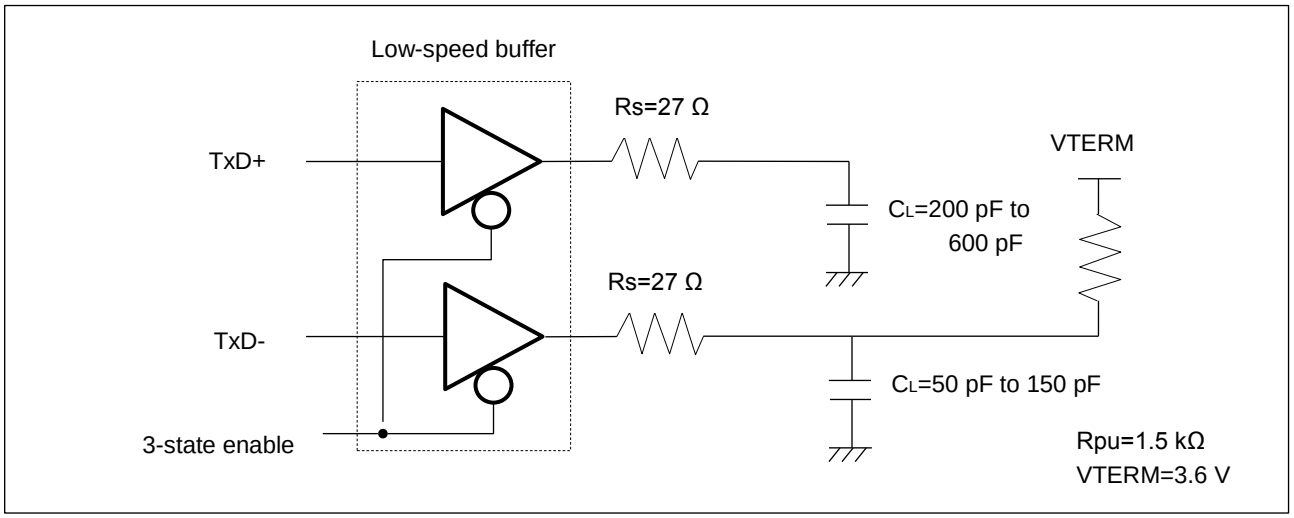


See “Low-speed load (Compliance Load)” for conditions of external load.

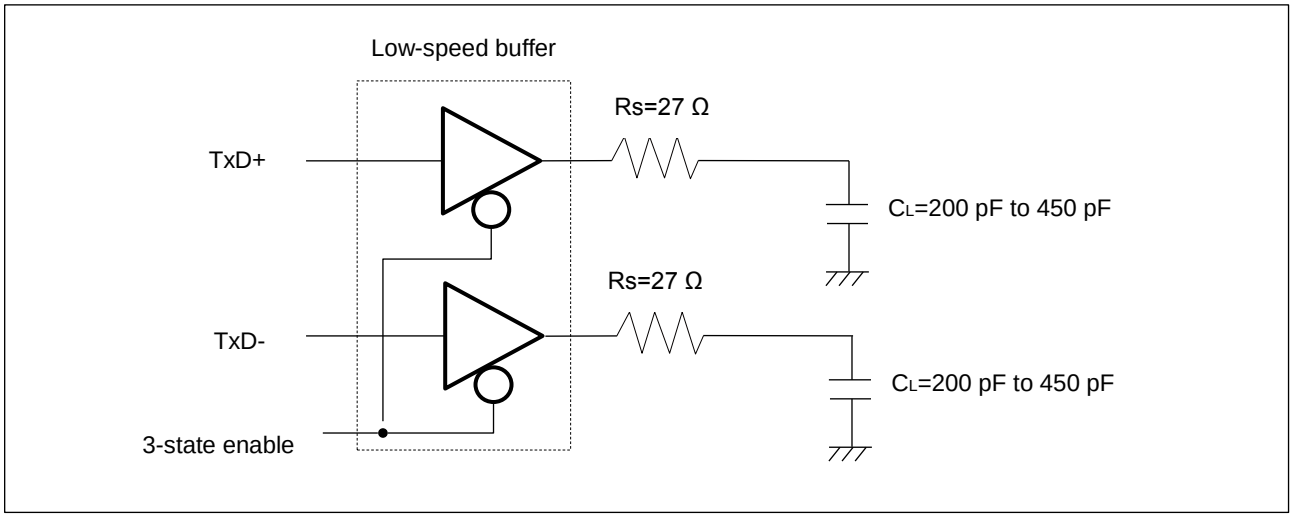
- Low-Speed Load (Upstream Port Load) – Reference 1



- Low-Speed Load (Downstream Port Load) – Reference 2



- Low-Speed Load (Compliance Load)



11.7 Low-Voltage Detection Characteristics

11.7.1 Low-Voltage Detection Reset

(T_A=-40°C to +105°C)

Parameter	Symbol	Conditions	Value			Unit	Remarks
			Min	Typ	Max		
Detected voltage	VDL	Fixed[67]	1.38	1.50	1.60	V	When voltage drops
Released voltage	VDH		1.43	1.55	1.65	V	When voltage rises
LVD stabilization wait time	T_{LVDW}	-	-	-	8160× t_{CYCP}[68]	µs	
LVD detection delay time	T_{LVDDL}	-	-	-	200	µs	

[67] The value of low voltage detection reset is always fixed.
[68] t_{CYCP} indicates the APB1 bus clock cycle time.

11.7.2 Low-Voltage Detection Interrupt

(T_A=-40°C to +105°C)

Parameter	Symbol	Conditions	Value			Unit	Remarks
			Min	Typ	Max		
Detected voltage	VDL	SVHI=00100	1.56	1.70	1.84	V	When voltage drops
Released voltage	VDH		1.61	1.75	1.89	V	When voltage rises
Detected voltage	VDL	SVHI=00101	1.61	1.75	1.89	V	When voltage drops
Released voltage	VDH		1.66	1.80	1.94	V	When voltage rises
Detected voltage	VDL	SVHI=00110	1.66	1.80	1.94	V	When voltage drops
Released voltage	VDH		1.70	1.85	2.00	V	When voltage rises
Detected voltage	VDL	SVHI=00111	1.70	1.85	2.00	V	When voltage drops
Released voltage	VDH		1.75	1.90	2.05	V	When voltage rises
Detected voltage	VDL	SVHI=01000	1.75	1.90	2.05	V	When voltage drops
Released voltage	VDH		1.79	1.95	2.11	V	When voltage rises
Detected voltage	VDL	SVHI=01001	1.79	1.95	2.11	V	When voltage drops
Released voltage	VDH		1.84	2.00	2.16	V	When voltage rises
Detected voltage	VDL	SVHI=01010	1.84	2.00	2.16	V	When voltage drops
Released voltage	VDH		1.89	2.05	2.21	V	When voltage rises
Detected voltage	VDL	SVHI=01011	1.89	2.05	2.21	V	When voltage drops
Released voltage	VDH		1.93	2.10	2.27	V	When voltage rises
Detected voltage	VDL	SVHI=01100	2.30	2.50	2.70	V	When voltage drops
Released voltage	VDH		2.39	2.60	2.81	V	When voltage rises
Detected voltage	VDL	SVHI=01101	2.39	2.60	2.81	V	When voltage drops
Released voltage	VDH		2.48	2.70	2.92	V	When voltage rises
Detected voltage	VDL	SVHI=01110	2.48	2.70	2.92	V	When voltage drops
Released voltage	VDH		2.58	2.80	3.02	V	When voltage rises
Detected voltage	VDL	SVHI=01111	2.58	2.80	3.02	V	When voltage drops
Released voltage	VDH		2.67	2.90	3.13	V	When voltage rises
Detected voltage	VDL	SVHI=10000	2.67	2.90	3.13	V	When voltage drops
Released voltage	VDH		2.76	3.00	3.24	V	When voltage rises
Detected voltage	VDL	SVHI=10001	2.76	3.00	3.24	V	When voltage drops
Released voltage	VDH		2.85	3.10	3.35	V	When voltage rises
Detected voltage	VDL	SVHI=10010	2.85	3.10	3.35	V	When voltage drops
Released voltage	VDH		2.94	3.20	3.46	V	When voltage rises
Detected voltage	VDL	SVHI=10011	2.94	3.20	3.46	V	When voltage drops
Released voltage	VDH		3.04	3.30	3.56	V	When voltage rises
LVD stabilization wait time	T_{LVDW}	-	-	-	8160 × t_{CYCP}[69]	µs	
LVD detection delay time	T_{LVDDL}	-	-	-	200	µs	

[69] t_{CYCP} represents the APB1 bus clock cycle time.

11.8 Flash Memory Write/Erase Characteristics

(V_{CC}=1.65 V to 3.6 V, T_A=- 40°C to +105°C)

Parameter		Value[70]			Unit	Remarks
		Min	Typ	Max		
Sector erase time	Large sector	-	1.1	2.7	s	The sector erase time includes the time of writing prior to internal erase.
	Small sector	-	0.3	0.9		
Halfword (16-bit) write time		-	30	528	µs	The halfword (16-bit) write time excludes the system-level overhead.
Chip erase time		-	4.5	11.7	s	The chip erase time includes the time of writing prior to internal erase.

Write/Erase Cycle and Data Hold Time

Write/Erase Cycle	Data Hold Time (Year)	Remarks
1,000	20	These values come from the technology qualification (using Arrhenius equation to translate high temperature acceleration test result into average temperature value at +85°C).
10,000	10	

[70] The typical value is immediately after shipment, the maximum value is guarantee value under 10,000 cycle of erase/write.

11.9 Return Time from Low-Power Consumption Mode

11.9.1 Return Factor: Interrupt/WKUP

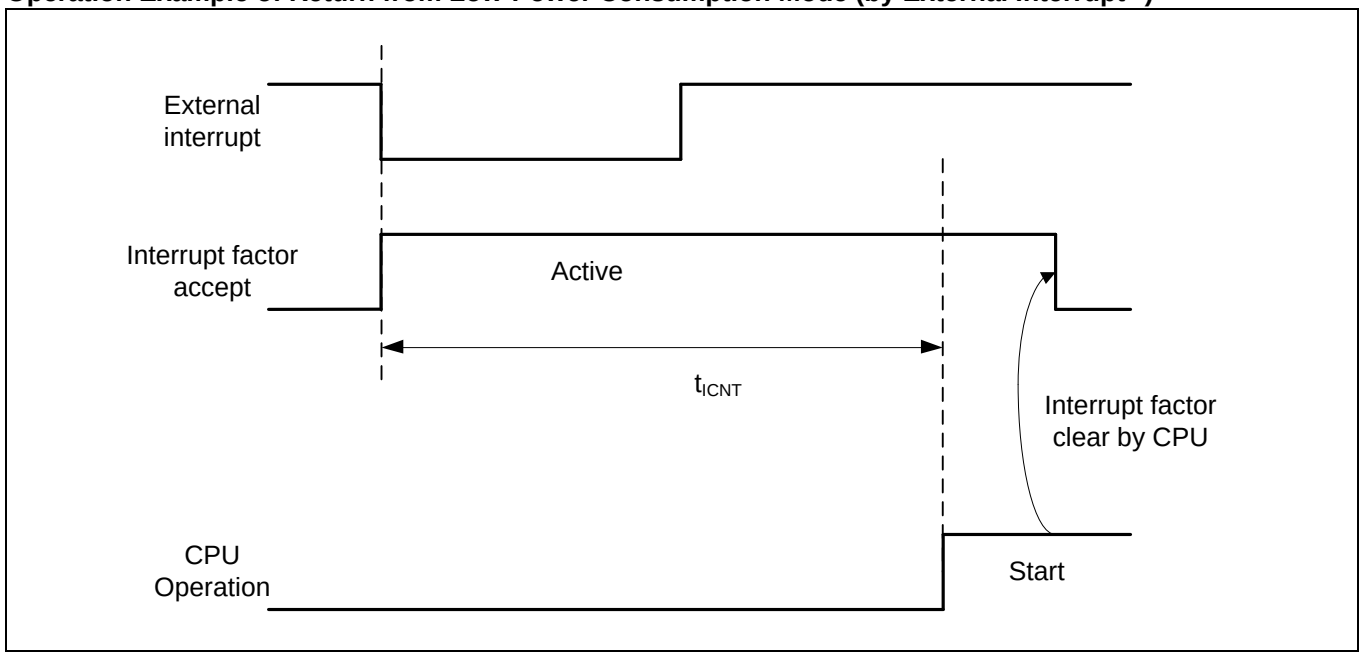
The return time from Low-Power consumption mode is indicated as follows. It is from receiving the return factor to starting the program operation.

Return Count Time

(V_{CC}=1.65 V to 3.6 V, T_A=-40°C to +105°C)

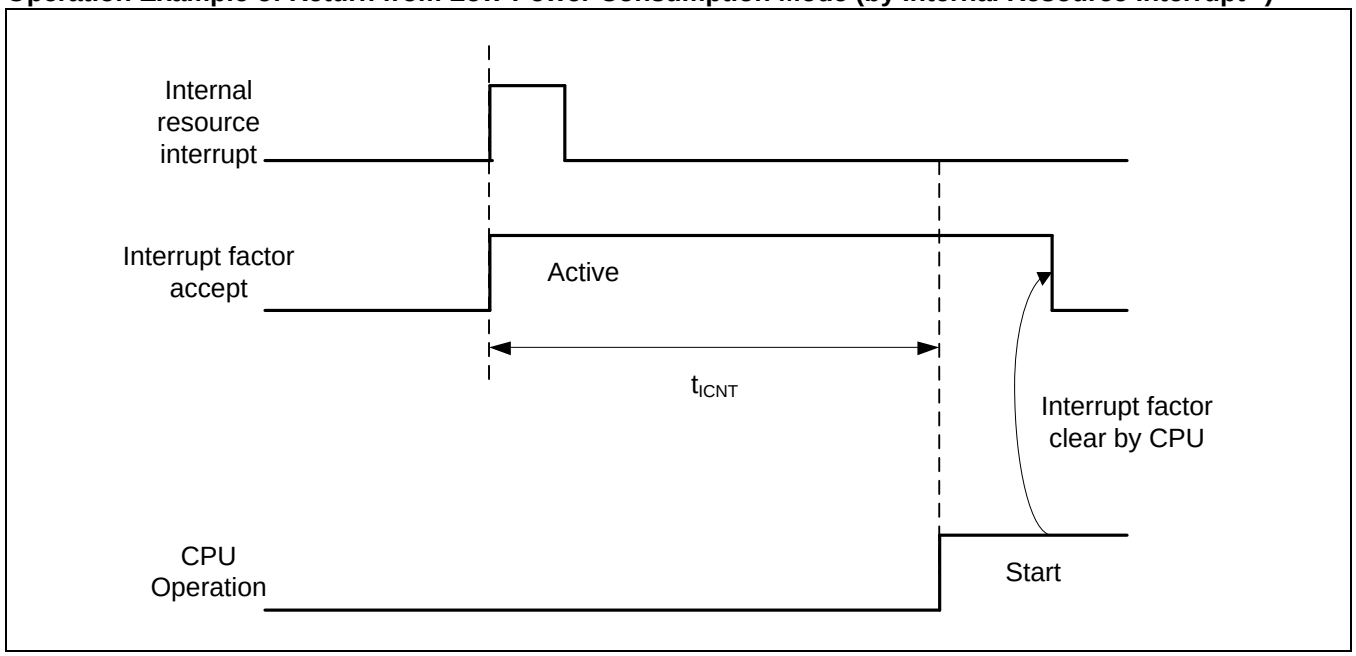
Parameter		Symbol	Value		Unit	Remarks
Current Mode	Mode to return		Typ	Max[71]		
Sleep mode	each Run Mode	t_{ICNT}	4*HCLK		µs	When High-speed CR is enabled
Timer mode	High-speed CR Run mode Main Run mode PLL Run mode		12*HCLK	13*HCLK	µs	When High-speed CR is enabled
	Low-speed CR Run mode Sub Run mode		34+12*HCLK	72+13*HCLK	µs	
Stop Mode	High-speed CR Run mode Low-speed CR Run mode		34+12*HCLK	72+13*HCLK	µs	
	Main Run mode Sub Run mode PLL Run mode		34+12*HCLK +t_{OSCWT}	72+13*HCLK +t_{OSCWT}	µs	[72]
RTC mode	High-speed CR Run mode Low-speed CR Run mode Sub Run mode		34+12*HCLK	72+13*HCLK	µs	
	Main Run mode PLL Run mode		34+12*HCLK +t_{OSCWT}	72+13*HCLK +t_{OSCWT}	µs	[72]
Deep Standby RTC mode Deep Standby Stop mode	High-speed CR Run mode		43	281	µs	

Operation Example of Return from Low-Power Consumption Mode (by External Interrupt[73])



[71] The maximum value depends on the condition of environment.
[72] t_{OSCWT}: Oscillator stabilization time.
[73] External interrupt is set to detecting fall edge.

Operation Example of Return from Low-Power Consumption Mode (by Internal Resource Interrupt[74])



Notes:

- *The return factor is different in each Low-Power consumption modes. See "Chapter: Low Power Consumption Mode" and "Operations of Standby Modes" in FM0+ Family Peripheral Manual.*
- *When interrupt recovers, the operation mode that CPU recovers depends on the state before the Low-Power consumption mode transition. See "Chapter: Low Power Consumption Mode" in "FM0+ Family Peripheral Manual".*

[74] Internal resource interrupt is not included in return factor by the kind of Low-Power consumption mode.

11.9.2 Return Factor: Reset

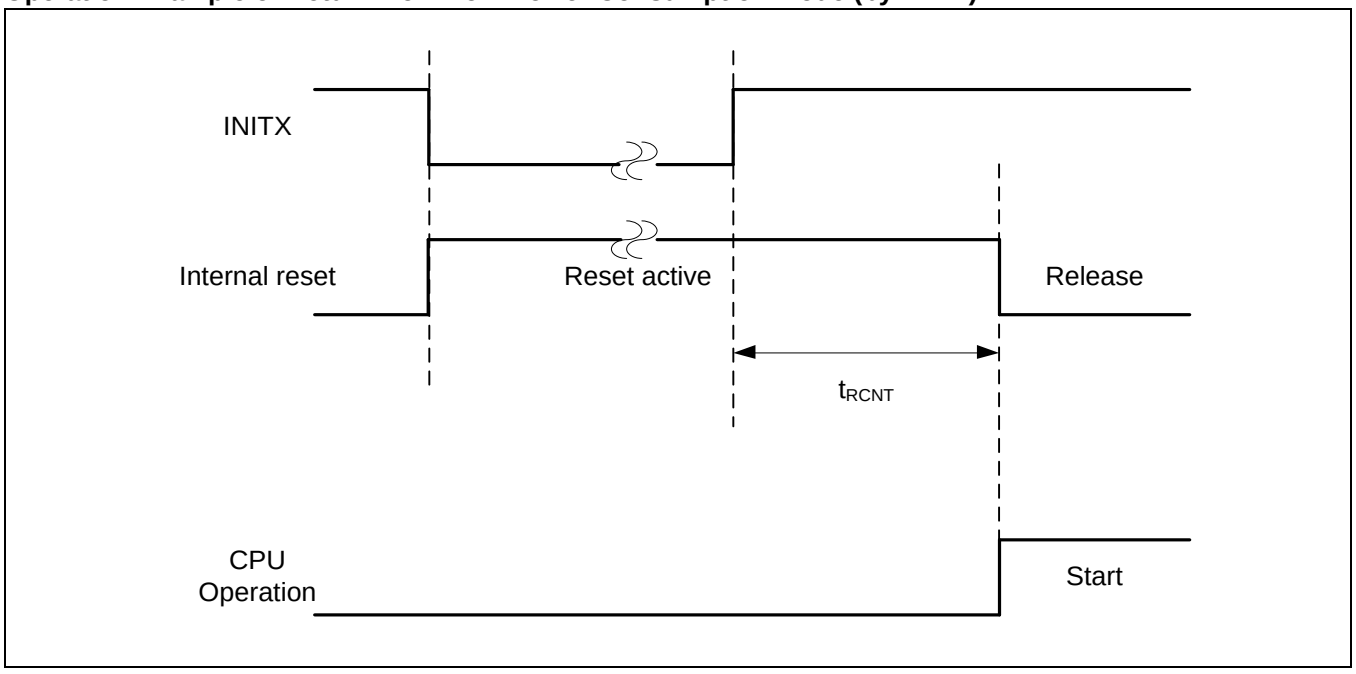
The return time from Low-Power consumption mode is indicated as follows. It is from releasing reset to starting the program operation.

Return Count Time

(V_{CC}=1.65 V to 3.6 V, T_A=-40°C to +105°C)

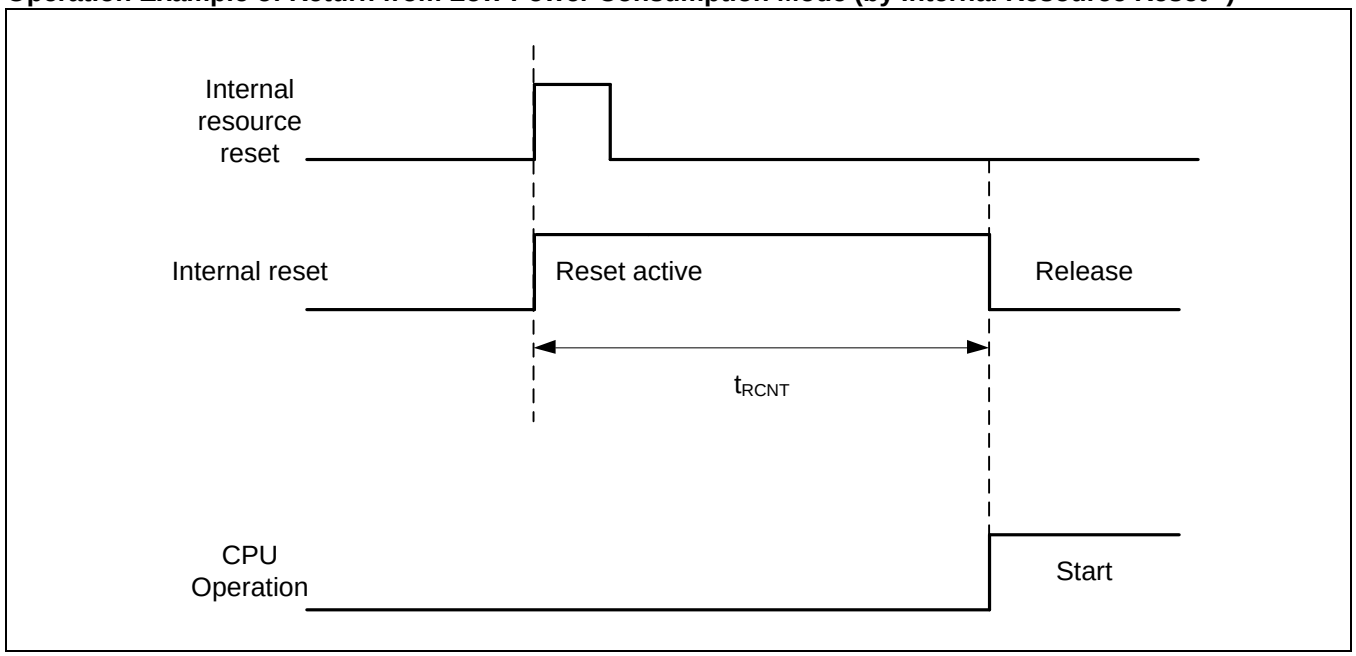
Parameter		Symbol	Value		Unit	Remarks
Current Mode	Mode to return		Typ	Max[75]		
High-speed CR Sleep mode Main Sleep mode PLL Sleep mode	High-speed CR Run mode	t_{RCNT}	20	22	µs	When High-speed CR is enabled
Low-speed CR Sleep mode			50	106	µs	When High-speed CR is enabled
Sub Sleep mode			112	137	µs	When High-speed CR is enabled
High-speed CR Timer mode Main Timer mode PLL Timer mode			20	22	µs	When High-speed CR is enabled
Low-speed CR Timer mode			87	159	µs	
Sub Timer mode			148	209	µs	
Stop mode RTC mode			45	68	µs	
Deep Standby RTC mode Deep Standby Stop mode			43	281	µs	

Operation Example of Return from Low-Power Consumption Mode (by INITX)



[75] The maximum value depends on the accuracy of built-in CR.

Operation Example of Return from Low Power Consumption Mode (by Internal Resource Reset[76])



Notes:

- *The return factor is different in each Low-Power consumption modes.*
  See "Chapter: Low Power Consumption Mode" and "Operations of Standby Modes" in FM0+ Family Peripheral Manual.
- *When interrupt recovers, the operation mode that CPU recovery depends on the state before the Low-Power consumption mode transition. See "Chapter: Low Power Consumption Mode" in "FM0+ Family Peripheral Manual".*
- *The time during the power-on reset/low-voltage detection reset is excluded. See "11.4.7 Power-on Reset Timing in 11.4 AC Characteristics in 11. Electrical Characteristics" for the detail on the time during the power-on reset/low -voltage detection reset.*
- *When in recovery from reset, CPU changes to the high-speed CR run mode. When using the main clock or the PLL clock, it is necessary to add the main clock oscillation stabilization wait time or the main PLL clock stabilization wait time.*
- *The internal resource reset means the watchdog reset and the CSV reset.*

[76] Internal resource reset is not included in return factor by the kind of Low-Power consumption mode.

12. Ordering Information

Part number	Flash [Kbyte]	SRAM [Kbyte]	USB2.0	I²S	Package-Specific Features (see next table)	Package (Tray)
S6E1C32D0AGV20000	128	16	✓	✓	64-pin	Plastic • LQFP (0.50 mm pitch), 64 pins (LQD064)
S6E1C31D0AGV20000	64	12	✓	✓		
S6E1C32C0AGV20000	128	16	✓	✓	48-pin	Plastic • LQFP (0.50 mm pitch), 48 pins (LQA048)
S6E1C31C0AGV20000	64	12	✓	✓		
S6E1C32B0AGP20000	128	16	✓		32-pin	Plastic • LQFP (0.80 mm pitch), 32 pins (LQB032)
S6E1C31B0AGP20000	64	12	✓			
S6E1C32D0AGN20000	128	16	✓	✓	64-pin	Plastic • QFN64 (0.50 mm pitch), 64 pins (WNS064)
S6E1C31D0AGN20000	64	12	✓	✓		
S6E1C32C0AGN20000	128	16	✓	✓	48-pin	Plastic • QFN48 (0.50 mm pitch), 48 pins (WNY048)
S6E1C31C0AGN20000	64	12	✓	✓		
S6E1C32B0AGN20000	128	16	✓		32-pin	Plastic • QFN32 (0.50 mm pitch), 32 pins (WNU032)
S6E1C31B0AGN20000	64	12	✓			
S6E1C32B0AGU1H000	128	16	✓		30-pin	Plastic • WLCSP30 (0.40 mm pitch), 30 pins (U4M030) * 7 inch reel only for this MPN
S6E1C12D0AGV20000	128	16		✓	64-pin	Plastic • LQFP (0.50 mm pitch), 64 pins (LQD064)
S6E1C11D0AGV20000	64	12		✓		
S6E1C12C0AGV20000	128	16		✓	48-pin	Plastic • LQFP (0.50 mm pitch), 48 pins (LQA048)
S6E1C11C0AGV20000	64	12		✓		
S6E1C12B0AGP20000	128	16			32-pin	Plastic • LQFP (0.80 mm pitch), 32 pins (LQB032)
S6E1C11B0AGP20000	64	12				
S6E1C12D0AGN20000	128	16		✓	64-pin	Plastic • QFN64 (0.50 mm pitch), 64 pins (WNS064)
S6E1C11D0AGN20000	64	12		✓		
S6E1C12C0AGN20000	128	16		✓	48-pin	Plastic • QFN48 (0.50 mm pitch), 48 pins (WNY048)
S6E1C11C0AGN20000	64	12		✓		
S6E1C12B0AGN20000	128	16			32-pin	Plastic • QFN32 (0.50 mm pitch), 32 pins (WNU032)
S6E1C11B0AGN20000	64	12				

Feature	Package			
	30 WLCSP	32 LQFP 32 QFN	48 LQFP 48 QFN	64 LQFP 64 QFN
Pin count	30	32	48	64
Multi-function Serial Interface (UART/CSIO/I²C/I²S)	4 ch. (Max) Ch.0/1/3 without FIFO Ch. 6 with FIFO		6 ch. (Max) Ch.0/1/3 without FIFO Ch.4/6/7 with FIFO	6 ch. (Max) Ch.0/1/3 without FIFO Ch.4/6/7 with FIFO
	I²S: No		I²S: 1 ch (Max) Ch. 6 with FIFO	I²S: 2 ch (Max) Ch. 4/6 with FIFO
External Interrupt	7 pins (Max), NMI x 1		9 pins (Max), NMI x 1	12 pins (Max), NMI x 1
I/O port	24 pins (Max)		38 pins (Max)	54 pins (Max)
12-bit A/D converter	6 ch. (1 unit)		8 ch. (1 unit)	8 ch. (1 unit)
Smart Card Interface	No			1 ch (Max)
HDMI-CEC/ Remote Control Receiver	1 ch.(Max) Ch.1		2 ch (Max) Ch.0/1	

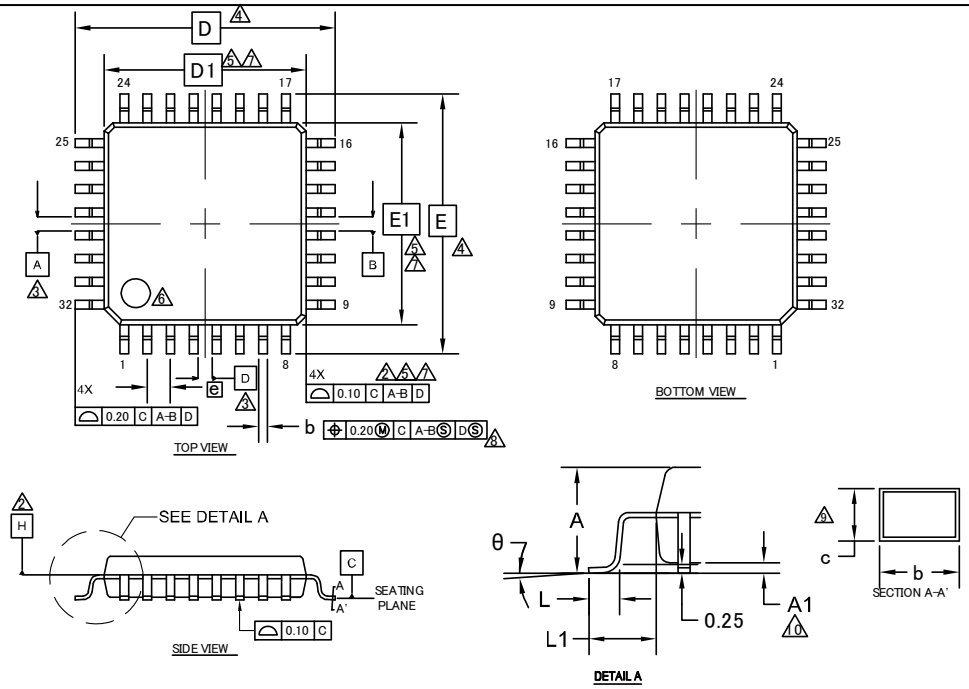
13. Acronyms

Acronym	Description
ADC	analog-to-digital converter
ACK	acknowledge
AHB	AMBA (advanced microcontroller bus architecture) high-performance bus, an ARM data transfer bus
ARM®	Advanced RISC Machine, a CPU architecture
CEC	Consumer Electronics Control, a command and control interface over HDMI (High Definition Multimedia Interface)
CMOS	complementary metal oxide semiconductor
CPU	central processing unit
CR	clock and reset
CRC	cyclic redundancy check, an error-checking protocol
CSIO	clock synchronous serial interface
CSV	clock supervisor
CTS	clear to send, a flow control signal in some data communication interfaces
DTSC	descriptor system data transfer controller
EOM	end of message
FIFO	first in, first out
GPIO	general-purpose input/output
HDMI	High Definition Multimedia Interface
HDMI-CEC	High Definition Multimedia Interface - Consumer Electronics Control, see CEC
I/F	interface
I²C, or IIC	Inter-Integrated Circuit, a communications protocol
I²S, or IIS	Inter-IC (integrated circuit) Sound, a communications protocol
I/O	input/output, see also GPIO
IRQ	interrupt request
LIN	Local Interconnect Network, a communications protocol
LVD	low-voltage detect
MFS	multi-function serial
MSB	most significant byte
MTB	micro trace buffer
NMI	non-maskable interrupt

Acronym	Description
NVIC	nested vectored interrupt controller
OS	operating system
OSC	oscillator
PLL	phase-locked loop
PPG	programmable pulse generator
PWC	pulse-width counter
PWM	pulse-width modulator
RAM	random access memory
RX	receive
RTS	request to send, a flow control signal in some data communication interfaces
SPI	Serial Peripheral Interface, a communications protocol
SRAM	static random access memory
SW-DP	serial wire debug port
TX	transmit
UART	universal asynchronous receiver transmitter
USB	Universal Serial Bus

14. Package Dimensions

Package Type	Package Code
LQFP-32	LQB032



SYMBOL	DIMENSIONS		
	MIN.	NOM.	MAX.
A	——	——	1.60
A1	0.05	——	0.15
b	0.32	0.35	0.43
c	0.13	——	0.18
D	9.00 BSC		
D1	7.00 BSC		
e	0.80 BSC		
E	9.00 BSC		
E1	7.00 BSC		
L	0.45	0.60	0.75
L1	0.30	0.50	0.70
θ	0°	——	8°

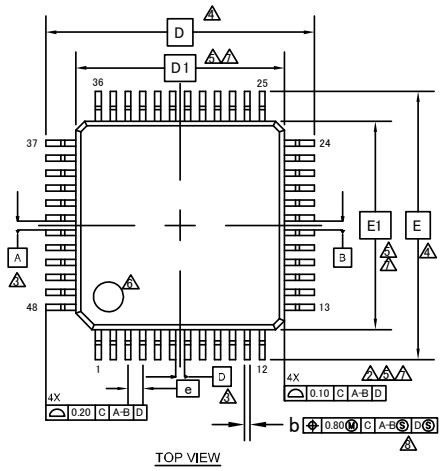
NOTES

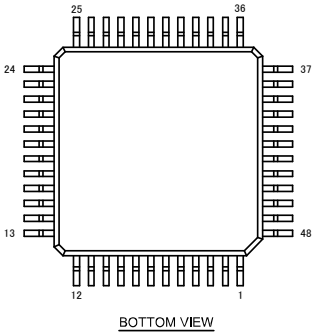
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DATUM PLANE H IS LOCATED AT THE BOTTOM OF THE MOLD PARTING LINE COINCIDENT WITH WHERE THE LEAD EXITS THE BODY.
3. DATUMS A-B AND D TO BE DETERMINED AT DATUM PLANE H.
4. TO BE DETERMINED AT SEATING PLANE C.
5. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25mm PRE SIDE. DIMENSIONS D1 AND E1 INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE H.
6. DETAILS OF PIN 1 IDENTIFIER ARE OPTIONAL BUT MUST BE LOCATED WITHIN THE ZONE INDICATED.
7. REGARDLESS OF THE RELATIVE SIZE OF THE UPPER AND LOWER BODY SECTIONS. DIMENSIONS D1 AND E1 ARE DETERMINED AT THE LARGEST FEATURE OF THE BODY EXCLUSIVE OF MOLD FLASH AND GATE BURRS. BUT INCLUDING ANY MISMATCH BETWEEN THE UPPER AND LOWER SECTIONS OF THE MOLDER BODY.
8. DIMENSION b DOES NOT INCLUDE DAMBER PROTRUSION. THE DAMBAR PROTRUSION (S) SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED b MAXIMUM BY MORE THAN 0.08mm. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE LEAD FOOT.
9. THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.10mm AND 0.25mm FROM THE LEAD TIP.
10. A1 IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY.

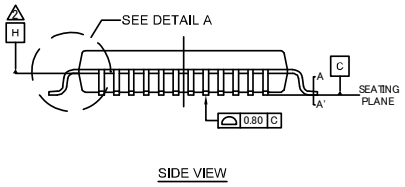
PACKAGE OUTLINE, 32 LEAD LQFP
7.0X7.0X1.6 MM LQB032 REV**

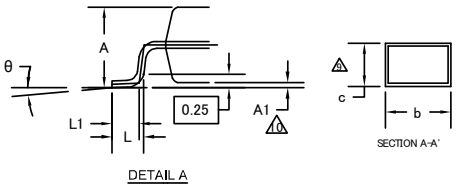
002-13879 **

Package Type	Package Code
LQFP-48	LQA048









SYMBOL	DIMENSIONS		
	MIN.	NOM.	MAX.
A	—	—	1.70
A1	0.00	—	0.20
b	0.15	—	0.27
c	0.09	—	0.20
D	9.00 BSC		
D1	7.00 BSC		
e	0.50 BSC		
E	9.00 BSC		
E1	7.00 BSC		
L	0.45	0.60	0.75
L1	0.30	0.50	0.70
θ	0°	—	8°

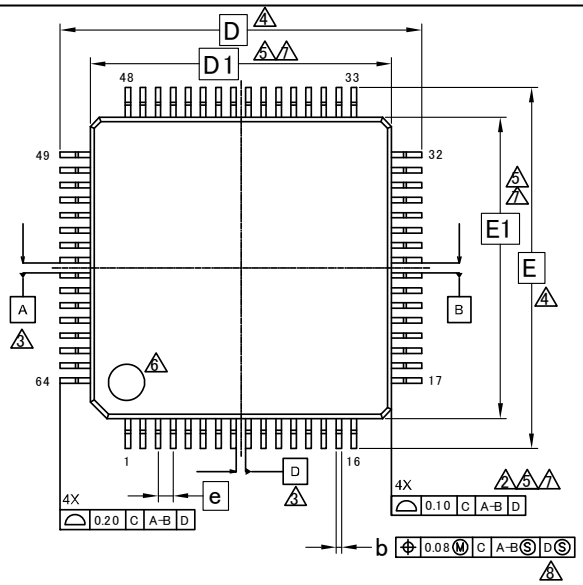
NOTES

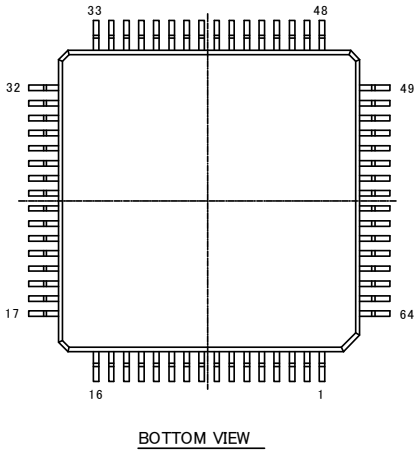
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DATUM PLANE H IS LOCATED AT THE BOTTOM OF THE MOLD PARTING LINE COINCIDENT WITH WHERE THE LEAD EXITS THE BODY.
3. DATUMS A-B AND D TO BE DETERMINED AT DATUM PLANE H.
4. TO BE DETERMINED AT SEATING PLANE C.
5. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25mm PRE SIDE. DIMENSIONS D1 AND E1 INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE H.
6. DETAILS OF PIN 1 IDENTIFIER ARE OPTIONAL BUT MUST BE LOCATED WITHIN THE ZONE INDICATED.
7. REGARDLESS OF THE RELATIVE SIZE OF THE UPPER AND LOWER BODY SECTIONS. DIMENSIONS D1 AND E1 ARE DETERMINED AT THE LARGEST FEATURE OF THE BODY EXCLUSIVE OF MOLD FLASH AND GATE BURRS. BUT INCLUDING ANY MISMATCH BETWEEN THE UPPER AND LOWER SECTIONS OF THE MOLDER BODY.
8. DIMENSION b DOES NOT INCLUDE DAMBER PROTRUSION. THE DAMBAR PROTRUSION (S) SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED b MAXIMUM BY MORE THAN 0.08mm. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE LEAD FOOT.
9. THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.10mm AND 0.25mm FROM THE LEAD TIP.
10. A1 IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY.

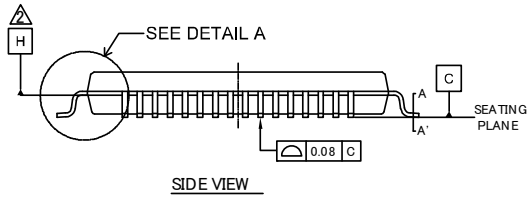
PACKAGE OUTLINE, 48 LEAD LQFP
7.0X7.0X1.7 MM LQA048 REV**

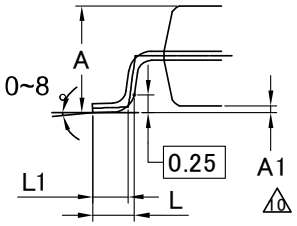
002-13731 **

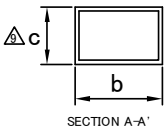
Package Type	Package Code
LQFP-64	LQD064











SYMBOL	DIMENSIONS		
	MIN.	NOM.	MAX.
A	—	—	1.70
A1	0.00	—	0.20
b	0.15	—	0.27
c	0.09	—	0.20
D	12.00 BSC.		
D1	10.00 BSC.		
e	0.50 BSC		
E	12.00 BSC.		
E1	10.00 BSC.		
L	0.45	0.60	0.75
L1	0.30	0.50	0.70

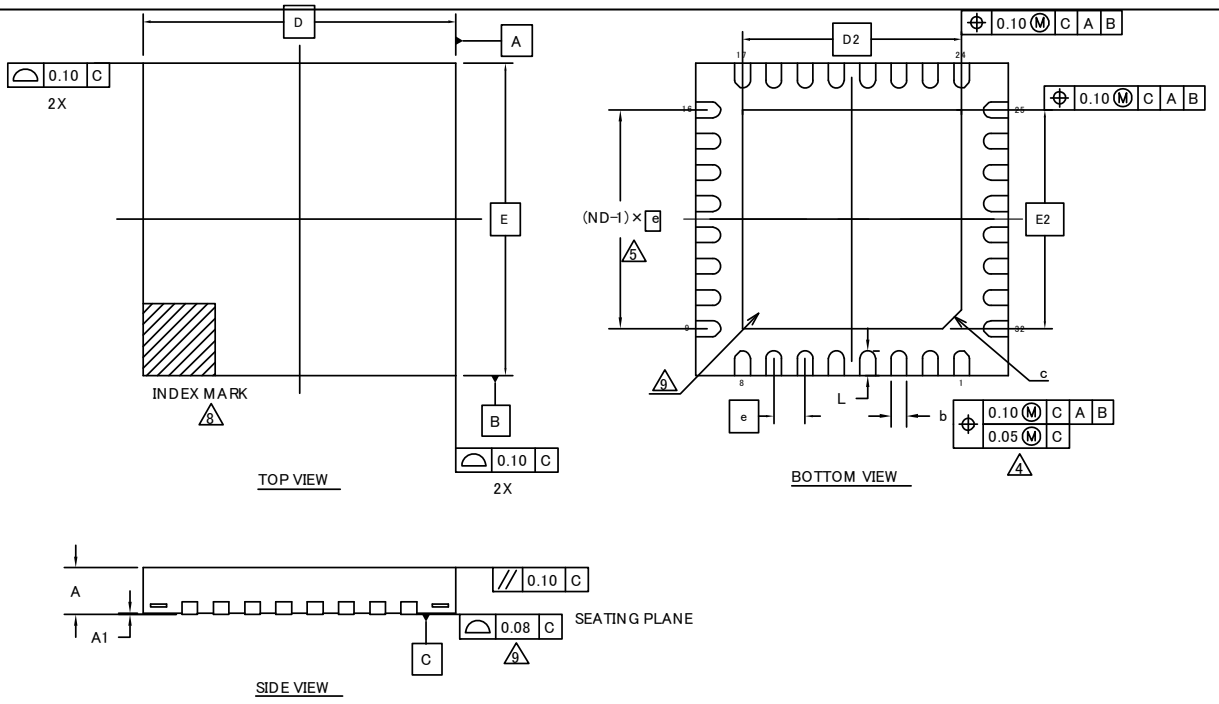
NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DATUM PLANE H IS LOCATED AT THE BOTTOM OF THE MOLD PARTING LINE COINCIDENT WITH WHERE THE LEAD EXITS THE BODY.
3. DATUMS A-B AND D TO BE DETERMINED AT DATUM PLANE H.
4. TO BE DETERMINED AT SEATING PLANE C.
5. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.25mm PRE SIDE. DIMENSIONS D1 AND E1 INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE H.
6. DETAILS OF PIN 1 IDENTIFIER ARE OPTIONAL BUT MUST BE LOCATED WITHIN THE ZONE INDICATED.
7. REGARDLESS OF THE RELATIVE SIZE OF THE UPPER AND LOWER BODY SECTIONS. DIMENSIONS D1 AND E1 ARE DETERMINED AT THE LARGEST FEATURE OF THE BODY EXCLUSIVE OF MOLD FLASH AND GATE BURRS. BUT INCLUDING ANY MISMATCH BETWEEN THE UPPER AND LOWER SECTIONS OF THE MOLDER BODY.
8. DIMENSION b DOES NOT INCLUDE DAMBER PROTRUSION. THE DAMBAR PROTRUSION (S) SHALL NOT CAUSE THE LEAD WIDTH TO EXCEED b MAXIMUM BY MORE THAN 0.08mm. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE LEAD FOOT.
9. THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.10mm AND 0.25mm FROM THE LEAD TIP.
10. A1 IS DEFINED AS THE DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY.

PACKAGE OUTLINE, 64 LEAD LQFP
10.0X10.0X1.7 MM LQD064 Rev**

002-11499 **

Package Type	Package Code
QFN-32	WNU032



SYMBOL	DIMENSIONS		
	MIN.	NOM.	MAX.
A	——	——	0.80
A_1	0.00	——	0.05
D	5.00 BSC		
E	5.00 BSC		
b	0.20	0.25	0.30
D_2	3.20 BSC		
E_2	3.20 BSC		
e	0.50 BSC		
c	0.25 REF		
L	0.35	0.40	0.45

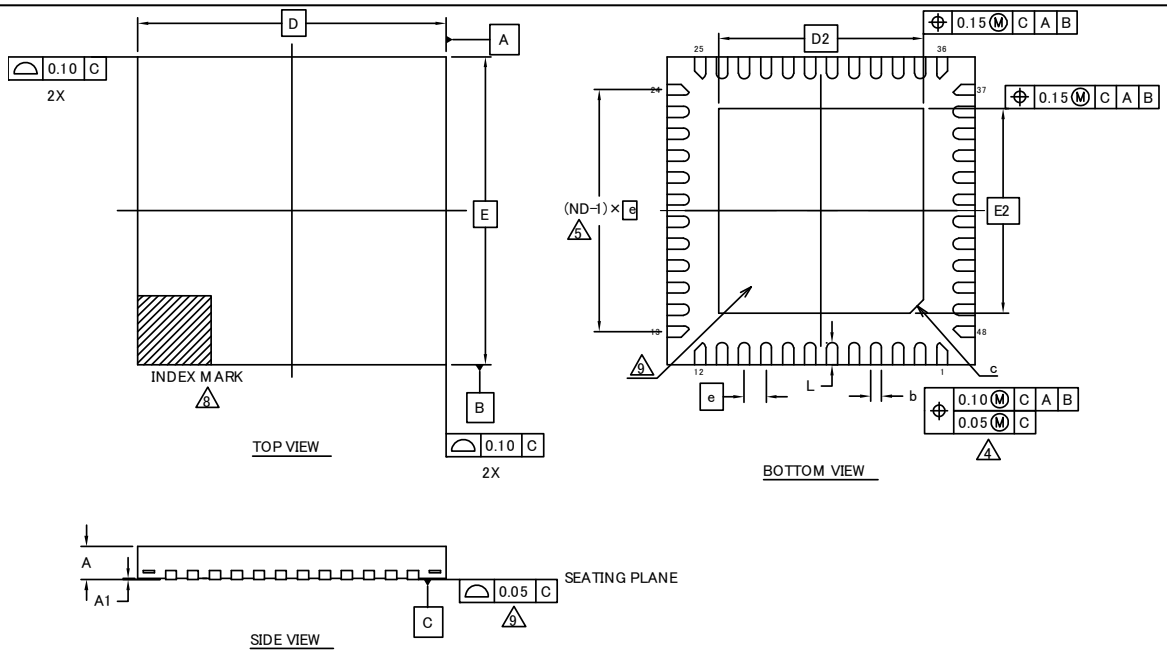
NOTE

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONING AND TOLERANCIN C CONFORMS TO ASME Y14.5–1994.
3. N IS THE TOTAL NU MBER OF TERMINALS.
4. DIMENSION "b" APPLIES TO META LLIZED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30mm FROM TERMINAL TIP.IF THE TERMINAL HAS THE OPTIONAL RADIUS ON THE OTHER END OF THE TERMINAL. THE DIMENSION "b"SHOULD NOT BE MEASURED IN THAT RADIUS AREA.
5. ND REFER TO THE NUMBER OF TERMINALS ON D OR E SIDE.
6. MAX. PACKAGE WARPAGE IS 0.05mm.
7. MAXIMUM ALLOWABL E BURRS IS 0.076mm IN ALL DIRECTIONS.
8. PIN #1 ID ON TOP WILL BE LOCATED WITHIN INDICATED ZONE.
9. BILATERAL COPLAN ARITY ZONE APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.
10. JEDEC SPEC IFICATION NO. REF : N/A

PACKAGE OUTLINE, 32 LEAD QFN
5.00X5.00X0.80 MM WNU032 3.20X3.20 MM EPAD (SAWN) REV**

002-15907 **

Package Type	Package Code
QFN-48	WNY048



SYMBOL	DIMENSIONS		
	MIN.	NOM.	MAX.
A	—	—	0.80
A_1	0.00	—	0.05
D	7.00 BSC		
E	7.00 BSC		
b	0.18	0.25	0.30
D_2	4.65 BSC		
E_2	4.65 BSC		
e	0.50 BSC		
c	0.30 REF		
L	0.45	0.50	0.55

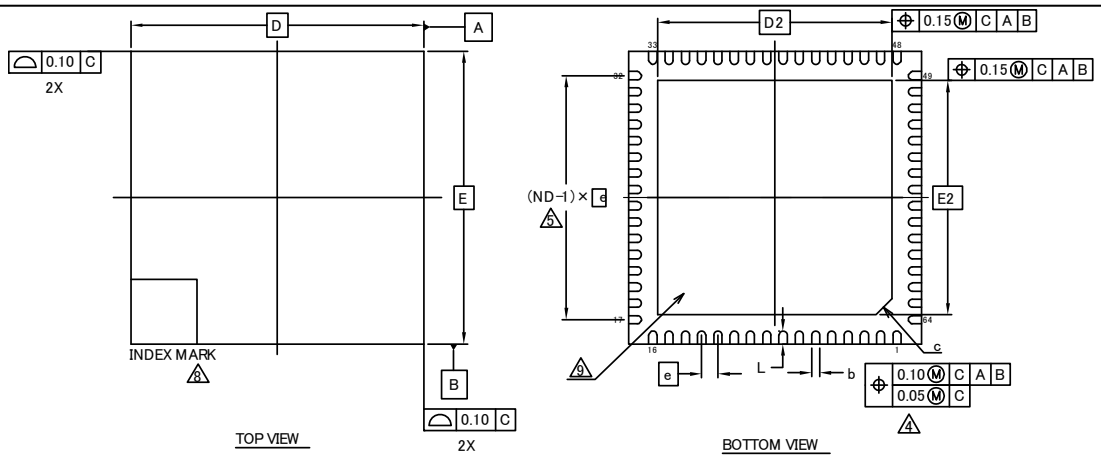
NOTE

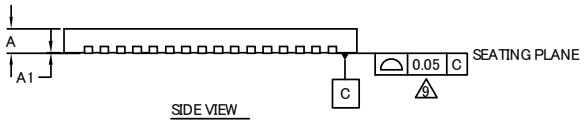
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONING AND TOLERANCING CONFORMS TO ASME Y14.5-1994.
3. N IS THE TOTAL NUMBER OF TERMINALS.
4. DIMENSION "b" APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30mm FROM TERMINAL TIP. IF THE TERMINAL HAS THE OPTIONAL RADIUS ON THE OTHER END OF THE TERMINAL. THE DIMENSION "b" SHOULD NOT BE MEASURED IN THAT RADIUS AREA.
5. AND REFER TO THE NUMBER OF TERMINALS ON D OR E SIDE.
6. MAX. PACKAGE WARPAGE IS 0.05mm.
7. MAXIMUM ALLOWABLE BURRS IS 0.076mm IN ALL DIRECTIONS.
8. PIN #1 ID ON TOP WILL BE LOCATED WITHIN INDICATED ZONE.
9. BILATERAL COPLANARITY ZONE APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.
10. JEDEC SPECIFICATION NO. REF : N/A

PACKAGE OUTLINE, 48 LEAD QFN
7.00X7.00X0.80 MM WNY048 4.65X4.65 MM EPAD (SAWN) REV**

002-16422 **

Package Type	Package Code
QFN-64	WNS064





SYMBOL	DIMENSIONS		
	MIN.	NOM.	MAX.
A	—	—	0.80
A_1	0.00	—	0.05
D		9.00 BSC	
E		9.00 BSC	
b	0.20	0.25	0.30
D_2		7.20 BSC	
E_2		7.20 BSC	
e		0.50 BSC	
c		0.50 REF	
L	0.35	0.40	0.45

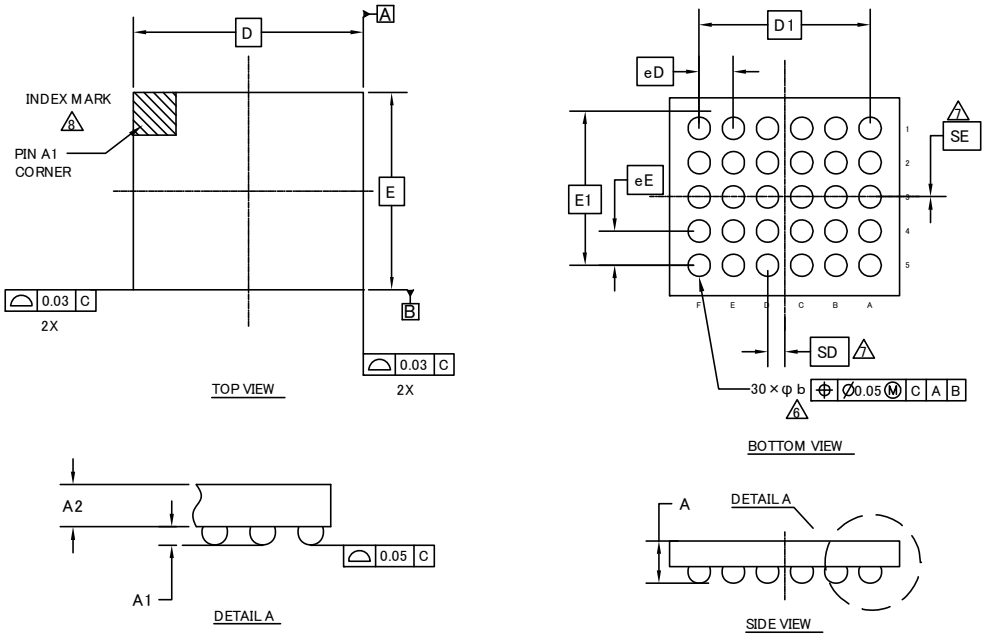
NOTE

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONING AND TOLERANCING CONFORMS TO ASME Y14.5-1994.
3. N IS THE TOTAL NUMBER OF TERMINALS.
4. DIMENSION "b" APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30mm FROM TERMINAL TIP. IF THE TERMINAL HAS THE OPTIONAL RADIUS ON THE OTHER END OF THE TERMINAL. THE DIMENSION "b" SHOULD NOT BE MEASURED IN THAT RADIUS AREA.
5. ND REFER TO THE NUMBER OF TERMINALS ON D OR E SIDE.
6. MAX. PACKAGE WARPAGE IS 0.05mm.
7. MAXIMUM ALLOWABLE BURRS IS 0.076mm IN ALL DIRECTIONS.
8. PIN #1 ID ON TOP WILL BE LOCATED WITHIN INDICATED ZONE.
9. BILATERAL COPLANARITY ZONE APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.
10. JEDEC SPECIFICATION NO. REF : N/A

PACKAGE OUTLINE, 64 LEAD QFN
9.00X9.00X0.80 MM WNS064 7.20X7.20 MM EPAD (SAWN) REV**

002-16424 **

Package Type	Package Code
WLCSP 30	U4M030



SYMBOL	DIMENSIONS		
	MIN.	NOM.	MAX.
A	—	—	0.534
A1	0.164	—	0.224
D	2.690 BSC		
E	2.310 BSC		
D1	2.000 BSC		
E1	1.600 BSC		
MD	6		
ME	5		
n	30		
φb	0.24	0.27	0.30
eD	0.400 BSC		
eE	0.40 BSC		
SD / SE	0.20 / 0 BSC		

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONS AND TOLERANCES METHODS PER ASME Y14.5-2009. THIS OUTLINE CONFORMS TO JEP95, SECTION 4.5.
3. BALL POSITION DESIGNATION PER JEP95, SECTION 3, SPP-010.
4. "e" REPRESENTS THE SOLDER BALL GRID PITCH.
5. SYMBOL "MD" IS THE BALL MATRIX SIZE IN THE "D" DIRECTION. SYMBOL "ME" IS THE BALL MATRIX SIZE IN THE "E" DIRECTION. n IS THE NUMBER OF POPULATED SOLDER BALL POSITIONS FOR MATRIX SIZE MD X ME.

6 DIMENSION "b" IS MEASURED AT THE MAXIMUM BALL DIAMETER IN A PLANE PARALLEL TO DATUM C.

7 "SD" AND "SE" ARE MEASURED WITH RESPECT TO DATUMS A AND B AND DEFINE THE POSITION OF THE CENTER SOLDER BALL IN THE OUTER ROW. WHEN THERE IS AN ODD NUMBER OF SOLDER BALLS IN THE OUTER ROW "SD" OR "SE" = 0. WHEN THERE IS AN EVEN NUMBER OF SOLDER BALLS IN THE OUTER ROW, "SD" = eD/2 AND "SE" = eE/2.

8 A1 CORNER TO BE IDENTIFIED BY CHAMFER, LASER OR INK MARK. METALLIZED MARK IN DENTATION OR OTHER MEANS.

9. "+" INDICATES THE THEORETICAL CENTER OF DEPOPULATED BALLS.
10. JEDEC SPECIFICATION NO. REF: N/A.

PACKAGE OUTLINE, 30 BALL WLCSP
2.31X2.69X0.534 MM U4M030 Rev**
002-18455 **

15. Errata

This chapter describes the errata for S6E1C product family. Details include errata trigger conditions, scope of impact, available workaround, and silicon revision applicability.

Contact your local Cypress Sales Representative if you have questions.

15.1 Part Numbers Affected

Part Number
S6E1C32D0AGV20000, S6E1C32C0AGV20000, S6E1C32B0AGP20000, S6E1C32D0AGN20000, S6E1C32C0AGN20000, S6E1C32B0AGN20000 S6E1C32B0AGU1H000
S6E1C31D0AGV20000, S6E1C31C0AGV20000, S6E1C31B0AGP20000, S6E1C31D0AGN20000, S6E1C31C0AGN20000, S6E1C31B0AGN20000
S6E1C12D0AGV20000, S6E1C12C0AGV20000, S6E1C12B0AGP20000, S6E1C12D0AGN20000, S6E1C12C0AGN20000, S6E1C12B0AGN20000
S6E1C11D0AGV20000, S6E1C11C0AGV20000, S6E1C11B0AGP20000, S6E1C11D0AGN20000, S6E1C11C0AGN20000, S6E1C11B0AGN20000

15.2 Qualification Status

Product Status: In Production − Qual.

15.3 Errata Summary

This table defines the errata applicability to available devices.

Items	Part Number	Silicon Revision	Fix Status
[1] AHB Bus Matrix issue	Refer to 15.1	Rev B	Fixed in Rev C
[2] Deep Standby Mode current consumption issue	Refer to 15.1	Rev B, Rev C	Next silicon is not planned.

15.4 Errata Detail

15.4.1 AHB Bus Matrix issue

■PROBLEM DEFINITION
The AHB Bus Matrix logic has two master interfaces (CPU and DSTC) and four slave interfaces (RAM, FLASH, AHB and APB). When two master interfaces (CPU and DSTC) access the same slave interface at the same time, and when the CPU is in wait cycle, an unnecessary access occurs during the wait cycle and the expected access occurs again after the unnecessary access.

■PARAMETERS AFFECTED
N/A

■TRIGGER CONDITION(S)
CPU and DSTC access the same slave interface at the same time.

■SCOPE OF IMPACT
DSTC cannot be used.

■WORKAROUND
DSTC must not use.

■FIX STATUS
This issue is fixed in Rev C.

15.4.2 Deep Standby Mode current consumption issue

■PROBLEM DEFINITION
The current consumption does not decrease in Deep Standby Mode (Deep Standby RTC Mode and Deep Standby Stop Mode)

■PARAMETERS AFFECTED
N/A

■TRIGGER CONDITION(S)
MCU is in Deep Standby Mode and both MAINXC bits in SPSR and SUBXC bits in SUBOSC_CTL has not been cleared with 0b00 since power-on.

■SCOPE OF IMPACT
The current consumption does not decrease.

■WORKAROUND
Clear both MAINXC bits in SPSR and SUBXC bits in SUBOSC_CTL with 0b00.
Please note:
- Output pins become unstable state in a moment right after clearing these register bits with 0b00.
- You can set these register bits to any value after they are cleared with 0b00.

■FIX STATUS
The user uses the workaround to prevent this issue. The next silicon fixing this issue is not planned.

Document History

Document Title: S6E1C Series 32-bit ARM® Cortex®-M0+ FM0+ Microcontroller
Document Number: 002-00233

Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	4896074	TEKA	08/31/2015	New Spec.
*A	4955136	TEKA	10/9/2015	AC/DC characteristics updated. Typo fixed in “List of Pin Functions”.
*B	5158709	YUKT	03/04/2016	Added the frequency value of “Ta = - 10°C to + 105°C” on “11.4.3 Built-in CR Oscillation Characteristics”. Added the remark of “VCC < 0.2V” on “11.4.7 Power-on Reset Timing”. Added the measure condition of ICC on “11.3.1 Current Rating”. Changed the package outlines to cypress format on “13. Package Dimensions”. Changed the package codes to cypress codes on “3. Pin Assignment” and “12. Ordering Information”.
*C	5220682	MBGR	09/07/2016	Consolidated the C Series of Cypress MCUs into one data sheet. Minor updates to grammar. Made table footnotes consectutive. Corrected navigational aids (cross reference link colors). Added front matter to data sheet to match Cypress corporate style. Added tables to differentiate parts in 2 Product Lineup and 2.1 Package Dependent Features. Removed full multiplexed signal names from 4 Pin Assignment drawings. Added hyperlinks to 5 List of Pin Functions. 10 Pin Status in Each CPU State: Changed several instances of pullup register to pull up resistor. Expanded 12 Ordering Information. Fixed typo in Memory Map. Updated logo. Removed WLCSP information. Updated 11.4.7 Power-on Reset Timing. Added 15 Erratta. Added 13 Acronyms.
*D	5453786	YSKA	04/13/2017	Updated “15 Errata”(Page 106) Updated the schematic for “11.4.7 Power-on Reset Timing”(Page 56) Updated “14. Package Dimensions” (Page 99-105) Modify expressions of channel numbers for USB, I²S (Page 1) Added the Baud rate spec in “11.4.9 CSIO/SPI/UART Timing”.(Page 58, 60, 62, 64) Modify typo about Main oscillation (Page 41) Modified Real-Time Clock(RTC) in “3. Product Features in Detail” Deleted “second, or day of the week” in the Interrupt function.(Page 8) Added WLCSP package information(Page 1, 6, 6, 17, 19, 96, 97, 105) Deleted I²C slave related description(Page 4, 6, 38, 41, 76, 97)

Sales, Solutions, and Legal Information

Worldwide Sales and Design Support

Cypress maintains a worldwide network of offices, solution centers, manufacturer's representatives, and distributors. To find the office closest to you, visit us at Cypress Locations.

Products

ARM® Cortex® Microcontrollers	cypress.com/arm
Automotive	cypress.com/automotive
Clocks & Buffers	cypress.com/clocks
Interface	cypress.com/interface
Internet of Things	cypress.com/iot
Memory	cypress.com/memory
Microcontrollers	cypress.com/mcu
PSoC	cypress.com/psoc
Power Management ICs	cypress.com/pmic
Touch Sensing	cypress.com/touch
USB Controllers	cypress.com/usb
Wireless/RF	cypress.com/wireless

PSoC® Solutions

PSoC 1 | PSoC 3 | PSoC 4 | PSoC 5LP | PSoC 6

Cypress Developer Community

Forums | WICED IOT Forums | Projects | Video | Blogs | Training | Components

Technical Support

cypress.com/support

ARM and Cortex are the registered trademarks of ARM Limited in the EU and other countries.

All other trademarks or registered trademarks referenced herein are the property of their respective owners.

© Cypress Semiconductor Corporation, 2015-2017. This document is the property of Cypress Semiconductor Corporation and its subsidiaries, including Spansion LLC ("Cypress"). This document, including any software or firmware included or referenced in this document ("Software"), is owned by Cypress under the intellectual property laws and treaties of the United States and other countries worldwide. Cypress reserves all rights under such laws and treaties and does not, except as specifically stated in this paragraph, grant any license under its patents, copyrights, trademarks, or other intellectual property rights. If the Software is not accompanied by a license agreement and you do not otherwise have a written agreement with Cypress governing the use of the Software, then Cypress hereby grants you a personal, non-exclusive, nontransferable license (without the right to sublicense) (1) under its copyright rights in the Software (a) for Software provided in source code form, to modify and reproduce the Software solely for use with Cypress hardware products, only internally within your organization, and (b) to distribute the Software in binary code form externally to end users (either directly or indirectly through resellers and distributors), solely for use on Cypress hardware product units, and (2) under those claims of Cypress's patents that are infringed by the Software (as provided by Cypress, unmodified) to make, use, distribute, and import the Software solely for use with Cypress hardware products. Any other use, reproduction, modification, translation, or compilation of the Software is prohibited.

TO THE EXTENT PERMITTED BY APPLICABLE LAW, CYPRESS MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARD TO THIS DOCUMENT OR ANY SOFTWARE OR ACCOMPANYING HARDWARE, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. To the extent permitted by applicable law, Cypress reserves the right to make changes to this document without further notice. Cypress does not assume any liability arising out of the application or use of any product or circuit described in this document. Any information provided in this document, including any sample design information or programming code, is provided only for reference purposes. It is the responsibility of the user of this document to properly design, program, and test the functionality and safety of any application made of this information and any resulting product. Cypress products are not designed, intended, or authorized for use as critical components in systems designed or intended for the operation of weapons, weapons systems, nuclear installations, life-support devices or systems, other medical devices or systems (including resuscitation equipment and surgical implants), pollution control or hazardous substances management, or other uses where the failure of the device or system could cause personal injury, death, or property damage ("Unintended Uses"). A critical component is any component of a device or system whose failure to perform can be reasonably expected to cause the failure of the device or system, or to affect its safety or effectiveness. Cypress is not liable, in whole or in part, and you shall and hereby do release Cypress from any claim, damage, or other liability arising from or related to all Unintended Uses of Cypress products. You shall indemnify and hold Cypress harmless from and against all claims, costs, damages, and other liabilities, including claims for personal injury or death, arising from or related to any Unintended Uses of Cypress products.

Cypress, the Cypress logo, Spansion, the Spansion logo, and combinations thereof, WICED, PSoC, CapSense, EZ-USB, F-RAM, and Traveo are trademarks or registered trademarks of Cypress in the United States and other countries. For a more complete list of Cypress trademarks, visit cypress.com. Other names and brands may be claimed as property of their respective owners.